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LOGISTICS AND SUPPLY CHAIN COOPERATIVE AND COLLABORATIVE SPIRIT INDICES IN SOUTH KOREA

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LOGISTICS AND SUPPLY CHAIN COOPERATIVE AND COLLABORATIVE SPIRIT INDICES IN SOUTH KOREA

by

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Signed…KIM CHANG SOO…………………………………..

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Logistics and supply chain cooperative and collaborative spirit indices in South Korea

Chang Soo Kim

This study proposes criteria to diagnose, to analyse and to evaluate the extent of cooperation and collaboration between supply chain members within extensive inter-firm relationships in supply chains. A case study context examines cooperative and collaborative relationships between shipping companies and shippers as suppliers, manufacturers, distributers, retailers, exporters and importers. The components of cooperation and collaboration are analysed through literature reviews, interviews with industrial experts, content analysis, two-rounds of Q-sorting, and pilot testing. *Cooperation* is a subset of *collaboration* comprised of *transparency*, *fairness*, and *mutuality*, and *cooperation* and "relational strength" such as *trust* and *sustainability* constitute *collaboration*. A questionnaire survey generated 167 responses from shipping companies in South Korea. Exploratory factor analysis underpinned cooperative and collaborative spirit indices (CCSIs) that varied within the shipping industry, types of shipping registered, and vessel types. Confirmatory factor analysis supported good model fit, convergent and discriminant validity, and unidimensionality. A "target coefficient" identified second order factors and path analysis showed that *fairness*, *mutuality* and *cooperation* can foster *trust*, and mutual *trust* can cultivate *sustainability* although *transparency* does not necessarily lead to *trust*. CCSIs indicated modest cooperation and collaboration in the shipping industry and MANOVA revealed differences according to vessel types and contract periods. This research clarifies theories of cooperation. Enhanced CCSIs between shippers and shipping companies imply that shippers should extend two-way communication, mutuality, distributive fairness and sustainability with shipping companies. Maintaining relationships brings long run benefits. Further, shipping companies should continuously strive to gain trust from shippers and government should organise consultative groups, develop and disseminate exemplary cases and foster institutions to promote collaboration. The constructs and items deployed herein are generic, implying that the research model and CCSIs methods will be widely applicable.

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LIST OF ABBREVIATIONS

AGFI	Adjusted Goodness of Fit Index
AHP	Analytic Hierarchy Processes
AMOS	Analysis of Moment Structures
ANOVA	Analysis of Variance
AVE	Average Variance Extracted
BAP	Budget Allocation Processes
BOD	Benefit Of the Doubt
CA	Conjoint Analysis
CCSIs	Cooperative and Collaborative Spirit Indices
CFA1	Confirmatory Factor Analysis
CFA2	Common Factor Analysis
CFI	Comparative Fit Index
CR	Construct (or Composite) Reliability
CSI1	Cooperative Spirit Index
CSI2	Collaborative Spirit Index
CT	Contingency Theory
D^2	Squared Mahalanobis distance
DEA	Data Envelopment Analysis
DFT	Department For Transportation of the UK
EFA	Exploratory Factor Analysis
FA	Factor Analysis
FCL	Full Container Load
GFI	Goodness-of-fit index
GLS	Generalised Least Squares

GOF	Goodness-Of-Fit
GT	Gross Tonnage
HT	Hotelling’s Trace
IFI	Incremental Index of Fit
KMI	Korea Maritime Institute
KMO	Kaiser-Meyer-Olkin
KSA1	Korea Shipowners’ Association
KSA2	Korea Shipping Association
LCL	Less than Container Load
LISREL	Linear Structural Relations
LPI	Logistics Performance Index
MANOVA	Multivariate Analysis of Variance
MCA	Multi-Criteria procedure
MI	Modification Index
ML	Maximum Likelihood
MLE	Maximum Likelihood Estimation
MSA	Measure of Sampling Adequacy
NFI	Normed Fit Index
NVOCC	Non-Vessel Operating Common Carrier
PAF	Principal Axis Factoring
PCA	Principal Component Analysis
PNFI	Parsimony Normed Fit Index
PT	Pillai’s Trace
RBT	Resource Based Theory
RDT	Resource Dependency Theory

RLR	Roy’s Largest Root
RMR	Root Mean square Residual
RMSEA	Root Mean Square Error of Approximation
RNI	Relative Noncentrality Index
RO	Research Objective
RT	Relational Theory
SA	Sensitivity Analysis
SC	Supply Chain
SCC	Supply Chain Collaboration
SCCI	Supply Chain Collaboration Index
SCI	Supply Chain Integration
SCM	Supply Chain Management
SCT	Social Capital Theory
SEM	Structural Equation Modelling
SET	Social Exchange Theory
SPSS	Statistical Package for Social Sciences
SRMR	Standardized Root Mean Residual
TCT	Transaction Cost Theory
TLI	Tucker Lewis Index
Turkey LSD	Tukey’s extension of the Fisher Least Significant Difference
UA	Uncertainty Analysis
UCM	Unobserved Components Models
WL	Wilks’s Lambda
WLS	Weighted Least Squares

AUTHOR'S DECLARATION

At no time during the registration for the degree of *Doctor of Philosophy* has the author been registered for any other University award without prior agreement of the Graduate Sub-Committee.

Papers have been published and presented by the author including:

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Chapter 1 Introduction

This chapter begins by stating why this research was conducted. A brief description of the research gap and scope identifies the distinctiveness of this research. The ensuing research aim and objectives guide the direction of this research and the research methodology outlines how the research objectives can be accomplished. Two ancillary issues are also addressed: why one-side research is conducted and why the shipping industry of South Korea is chosen in terms of relationship between shipping companies and shippers. Finally, each chapter of this research is briefly introduced.

1.1 Research background

Across the world, the volume and network of international seaborne transport has been affected by increasingly globalised commerce. Over 80 percent of the world's merchandise trade by volume is being carried by sea (UNCTAD, 2016) and about 60 percent of commodities by value were internationally carried through the container shipping each year (Mason and Nair, 2012).

Such cases suggest that shipping logistics plays a pivotal role not only in a single country's but also in the global supply chains (SCs). "Ocean carriers play an under-recognised yet crucial role in global trade, linking SC partners through efficient, low-cost transportation and constituting the infrastructure of global SCs" (Maloni *et al.*, 2016, p. 959).

However, as the global economy becomes more open through the WTO and FTA agreements, the shipping industry repeatedly undergoes periodic crises similar to the repetitive cycle of the global financial crisis. Global container carriers have struggled to survive the ordeal caused by sluggish economy and overcapacity since the crisis and current shipping environment features complexity and unpredictability (Kuo *et al*., 2017).

As a way to overcome such fluctuations and current difficulties, this study proposes to introduce the so-called “cooperative and collaborative spirit indices (CCSIs) between shipping companies and shippers.”

In terms of relationship between shippers and logistics companies, logistics companies with weaker power than shippers want to commit more to the relationship than shippers (Golicic, 2007). Liner shipping companies confront powerful shippers such as multinational corporations and shipper strength is often a real issue because the powerful shipper tends to severely reduce its budget for transport (Stopford, 2009). Hence, to some extent, adversarial relationships between shippers and logistics parties such as common carriers and shipping lines have existed (Heaver, 2015).

Midoro *et al.* (2005) also note that shippers’ contractual power has increased in accordance with the imbalance between supply and demand as well as fierce competition in container shipping in the following ways: the globalisation of manufacturers has meant that carriers have had to cope with new demands from shippers to deliver goods globally and furthermore, carriers have faced chronic fleet overcapacity in terms of the supply side. Shipping companies have had to cope with increased costs arising from providing globalised services and also the entrance into shipping markets of new carriers has heightened competition in shipping markets globally (Slack *et al.*, 2002). In this vein, the main carriers have no choice but to adopt strategy enhancing economies of scale such as enlargement of vessel size and merger and acquisition because of extreme difficulty in keeping stable freight rates (dramatic fluctuations of freight rates) in the very competitive business environment (Midoro *et al.*, 2005). In other words, economies of scale create pressures to fill ships with freight and shipping lines subsequently have to accept whatever price the shipping market provides and consequently the shipping lines have had to put an emphasis on cost reduction (Notteboom *et al.*, 2010).

At the same time, the carriers have sought new forms of cooperation such as global alliances which are different from former conferences and consortia (Midoro *et al.*, 2005). It is generally agreed that globalisation and competition bring about a type of groupings among shipping lines (Slack *et al.*, 2002). To date there are four giant alliances in container shipping around the world: 2M (MEARSK and MSC), O3 (CMA-CGM, COSCO, and UASC), CKYHE and G6 (Hankyoung, 2015). Recently, to make the matter worse, Clarkson (2015) expects that upsizing trends on major trade lanes which have been caused by the greater economies of scale will be likely to continue and also notes that the first orders for vessels of 20,000+ TEU were placed in the first half of 2015. According to Kyunghyang (2015), on the Asia-Europe route, average vessel size has increased from 8,596 TEU to 13,596 TEU whereas the freight rate has sharply decreased from $1,771/TEU to $628/TEU between 2010 and 2015.

The alliances for reduced costs and risks have made carriers accentuate a price advantage rather than adopt a differentiation strategy of their services and capabilities (Maloni *et al.*, 2016). Overcapacity for outperforming their competitors has caused fierce competition and reduced profitability, which has had a destructive effect on the recovery of shipping markets (Kou and Luo, 2016).

In these highly competitive and shippers-dominant circumstances, from the position of shipping companies, it may be more important to create and maintain cooperative and collaborative relationships with shippers to survive. To put it another way, the cooperative and collaborative spirit of shippers such as guaranteeing reasonable profits, sharing additional benefits and costs, and long term contracts can be a great help to shipping lines which have struggled to cope with their predicament. Furthermore, it is very important whether shippers have cooperative and collaborative spirit towards shipping companies or not in that the source of income of shipping companies depends on shippers. As consumers of logistics services, shippers pay the prices or logistics costs which carriers impose (Talley and Ng, 2013). Similarly, Crum and Allen (1991) identify that in very competitive transportation markets in the USA, revenue from a single shipper explains 50% of revenues of many carriers and hence carriers are more dependent on shippers than vice versa.

If shippers regard shipping companies only as an object of managerial cost reduction not as a business partner, it can be expected that shipping companies would not grow properly and would not easily overcome the periodic crises caused from the fluctuations of global economy. Further, it would be more likely for the shipping companies to lose their chance to improve their competitiveness.

Hence, the importance of cooperative and collaborative relationship between shipping companies and shippers cannot be emphasised enough. In this respect, recently the cooperative and collaborative relationship between shipping companies and shippers has gained more attention.

Therefore, this study intends to examine a methodology which measures the overall level of cooperation and collaboration in the SC consisting of shipping companies and shippers as a case study of collaboration in SCs. Furthermore, through the development of the CCSIs, this research also attempts to provide criteria to test whether cooperation and collaboration between the parties exists or not and to diagnose the current state of cooperation and collaboration.

In terms of an index, generally, an index can present intuitive and well-defined understanding on a situation or a state. It might be possible to measure and compare changes of the index over time and among countries when a credible and trustworthy index is developed. To date, for these reasons, many indices have been developed by international organisations such as LPI (Logistics Performance Index by World Bank), GCI (Global Competitiveness Index by Global Competitiveness Forum) and CPI (Corruption Perceptions Index by Transparency International).

1.2 Research gap

Supply Chain Management (SCM) is based on the fundamental philosophy of cooperation and collaboration. Hence, much SCM and Supply Chain Integration (SCI) literature has addressed cooperation and collaboration in the context of SCM. The literature has focused on the composites representing cooperation and collaboration and their correlations and causalities. The main relationships in SC which have obtained attention are the relationships between suppliers and manufacturers and suppliers and retailers (Hudnurkar *et al.*, 2014).

However, literature addressing the measurement of Supply Chain Collaboration (SCC) has been limited (Simatupang and Sridharan, 2004) and the literature testing the current state and extent of cooperation and collaboration is scarce. Further, conceptualisation of collaboration has focused on only process integration in spite of multiple traits of collaboration (Cao *et al.*, 2010). Much literature has mainly stressed the importance and advantages of collaboration whereas it is also true that some cases of collaboration failure derived from power imbalances and a lack of trust are found (Sabath and Fontanella, 2002). In this vein, the exact understanding of the current situation of collaboration in a SC through reliable measures should be a springboard of discussion.

Although some literature (Kleinsorge *et al.,* 1991; Gardner *et al.,* 1994; Gibson *et al.*, 2002; Zsidisin *et al.,* 2007; Golicic, 2007; Fugate *et al.,* 2009) has studied cooperation and collaboration between shippers and carriers, most of it has addressed inland logistics, not maritime logistics. Maritime logistics has explained cooperation and collaboration among the participants in SC through the central concept of integration (Panayides, 2006). However, studies on SCI in maritime transport are very limited (Lam, 2011). Furthermore, reliable and generally accepted measurement instruments to measure SCC in the context of maritime logistics are extremely limited (Seo *et al.*, 2015).

Literature dealing with the cooperative and collaborative relationship between shippers and shipping companies synthetically and directly does not exist. Only small parts of the relationship are addressed in sparse literature. In addition, literature addressing the criteria regarding whether a cooperative and collaborative relationship between the two parties exists or not and understanding of the current state of cooperation and collaboration between them is minimal. Empirical tests of the relationship in SC contexts were not found.

1.3 Research scope

Daft *et al.* (1988, p.124) defines the business environment as "the relevant physical and social factors outside the boundary of an organisation that are taken into consideration during organisational decision-making." According to them, fundamentally, the business environment has been divided into the task environment and general environment which were pioneered by Dill (1958). Task environment consists of customers, suppliers, competitors, and regulatory groups which are external to a firm and general environment is composed of multiple task environments, namely "source of general, social, political, economic, demographic, and technological trends" (Bourgeois, 1980, p.26). Task environment is similar to the notion of industry in economics (Bourgeois, 1980). Xu *et al.* (2003, p.382) also state that "a common classification of the business environment is the internal versus external dimension, i.e. factors that fall within the boundary of the organisation constitute the internal environment, while factors beyond the boundary form the external environment".

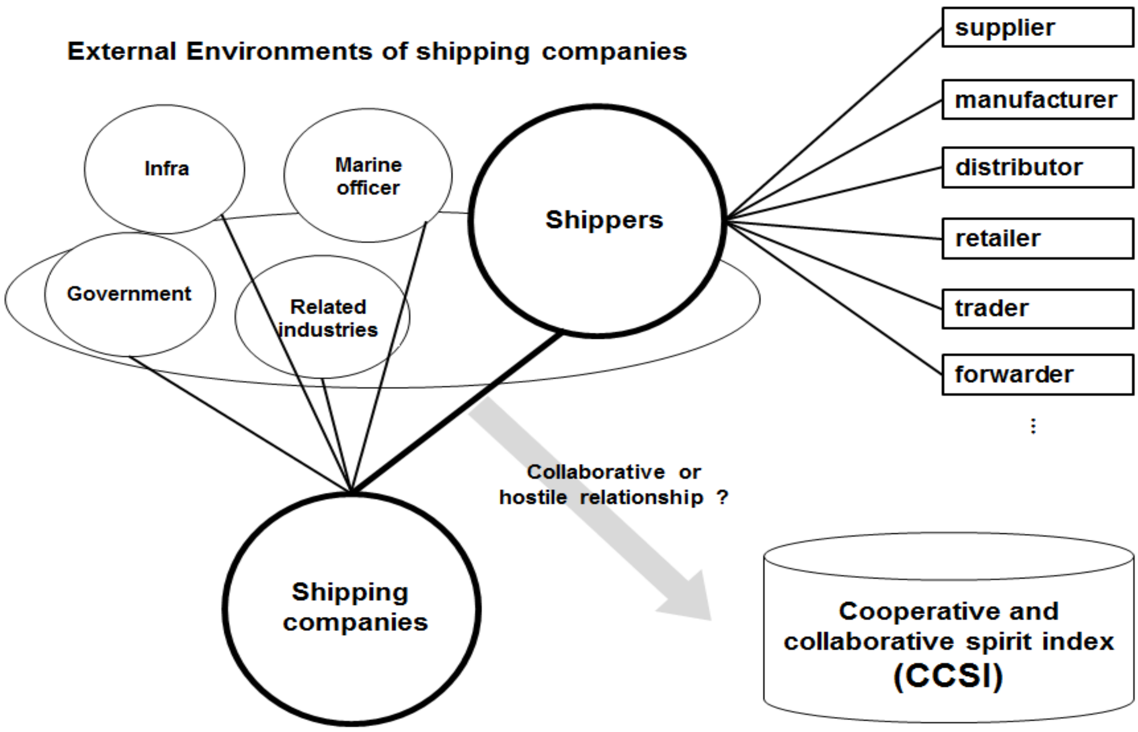
Because the business environment in each industry varies, it is necessary to identify the unique business environment surrounding shipping companies. Although the internal environment which includes the leadership of executives and their personnel who determine decision making processes is also believed to be very important for the performance and prosperity of a company, it might be true that each company has such a diverse and introspective environment that it is very hard to generalise the environment. Hence, only the external environment which shipping companies encounter will be dealt with in this study.

Generally, it is said that the external environment of a shipping business could be categorised into five major components from the view of a novice who wants to commence shipping management: infrastructure such as ports, hinterland, nodes and links; government; shippers; related industries such as finance, IT, stevedoring and inland transport); and marine officer. Among these components, in particular, shippers are examined along with the importance of relationships between shipping companies and shippers as mentioned already in Section One.

In terms of SCM, the scope of this study can also be explained. “SCM encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, SCM integrates supply and demand management within and across companies” (CSCMP, 2017). Hence, cooperation or collaboration among SC members can be referred to as key values in the SCM and logistics including maritime logistics as a major activity of SCM. However, the movement of goods in a SC can generate multiple inter-firm relationships and it is impossible to examine the gamut of extensive relationships within one study only in terms of cooperation and collaboration. Accordingly, this research adopted a SC comprised of shippers and shipping companies as a starting point for research concerning collaboration in SCs. As a case study of collaboration in SCs, the purview of this study is the cooperative and collaborative relationship between shipping companies and all companies which can be shippers. Almost all SC members such as suppliers, manufacturers, distributors, retailers, logistics service providers and traders who need maritime transport services and contract with shipping companies can function as shippers. Chapter Two details SCM, logistics, maritime logistics/transport, and shippers.

Figure 1-1 below delineates the purview of this literature. The relationships between shipping companies and shippers among several external environments of shipping companies are focused on and addressed. Through development of CCSIs, this research attempts to reveal and diagnose how much the relationships between the two parties are cooperative and collaborative.

Figure 1-1 Scope of this study



1.4 Research aim and objectives

In the light of the research gap identified and the importance of cooperation and collaboration in SCs, this study mainly addresses and measures the extent of cooperative and collaborative relationship between shipping companies and shippers as a case study of collaboration in SCs from the viewpoint of shipping companies. Through this, this study aims to suggest the criteria, namely the CCSIs, required to reveal whether cooperation or collaboration exists or not and to analyse and evaluate the extent of cooperation and collaboration. Based on this aim, the objectives of this study are as follows:

a. To identify components of the cooperative and collaborative relationship between shipping companies and shippers from the point of view of deep-sea and coastal shipping companies.

b. To explore correlations among components of the cooperative and collaborative relationship between shipping companies and shippers.

c. To create indices to measure the cooperative and collaborative relationship - including the indices of ocean-going and coastal shipping and the indices by sub-shipping industries (container, bulk, tanker, and others).

d. To identify the differences of indices according to types of shipping registered, sub-shipping industries and other variables.

e. To evaluate the extent of cooperation and collaboration between shipping companies and shippers through the indices scores.

f. To recommend how to enhance or foster the cooperative and collaborative relationship between them based on the indices scores.

This study develops CCSIs according to types of shipping registered (sea-going and coastal), vessel types or sub-industries of shipping (container, bulk, tanker and others) as well as overall CCSIs of the shipping industry of South Korea. The calculation of several different CCSIs is based on the proposition that the shippers according to the above classification criteria would be different and accordingly the attitudes of distinctive shippers towards shipping companies would not be the same. If the CCSIs were developed, it could be expected to be able to analyse and assess the overall experiences of shipping companies in relation to shippers. Besides, some policy tasks to improve the relationship between them could be derived.

1.5 Research methodology

Generally, methodology implies the theory of how a researcher should conduct research (Saunders *et al.*, 2016) whereas research methods define various techniques to collect and analyse data (Wilson, 2014).

In terms of philosophy, the perspective of this study is pragmatism. This is because subjectivism in ontology and post-positivism and interpretivism in epistemology are simultaneously considered for appropriate execution of Research Objectives (ROs). Cooperation and collaboration in SCs (social phenomenon) is believed to be created and developed by the social actors such as the SC members. This is why the ontological perspective of subjectivism is followed. The epistemological and axiological (value-free) perspectives of post-positivism are also followed. A cooperative and collaborative spirit between SC members is not believed to be an exact measure, but rather, is explored and estimated through the CCSIs. When the CCSIs are developed and some hypotheses are tested, the stance of post-positivism is strictly observed. However, at the stage of implication and conclusion of this study, the epistemological and axiological (value-laden) stance of interpretivism is also adopted. From an empathic view of weaker SC members' stance, some suggestions to reinforce the CCSIs are made.

Survey research strategy such as a questionnaire and an interview is adopted in line with the stance of positivism or post-positivism. To develop constructs and their items for measurement of the CCSIs, email interviews and Q-sorting technique with shipping experts as well as literature review are utilised. The questionnaire is developed through the above methods and pilot testing. To identify the relationships among components composing cooperation and collaboration, a few hypotheses are established in advance through literature review. To put it another way, a deductive research approach is mainly adopted. Some hypotheses related to the CCSIs are also developed deductively. However, an inductive approach is partly adopted in the stage of implications and conclusions. To recapitulate, the methodology of this study can be construed as following the perspective of pragmatism.

The analysis of the data is quantitatively implemented with such computer programs as Statistical Package for Social Sciences (SPSS 23) and Analysis of Moment Structures (AMOS 22). To purify the components and items of cooperation and collaboration, Exploratory Factor Analysis (EFA) is used. The EFA provides the weights of items and factors for computation of the CCSIs.

With Confirmatory Factor Analysis (CFA1), the relationships between components and their indicators are again identified. CFA1 also suggests standards of judgement about the reliabilities and validities of constructs as well as the model fit. The hypotheses representing the relationships among components of cooperation and collaboration are tested by structural equation modelling (SEM). The hypotheses related to the differences of the CCSIs along with types of shipping registered, vessel types, and period of contract are also tested with another statistical method, Multivariate Analysis of Variance (MANOVA).

The details regarding research methodology are discussed in Chapter Four.

1.6 Two ancillary issues

1.6.1 Is one-sided research reasonable?

The application of the opinions of only shipping companies about their cooperative and collaborative relationship with shippers can be problematic. It is widely considered that collecting data from both sides such as manufacturer and supplier can reduce biased assessment (Cao and Zhang, 2010).

However, the operational difficulties of acquiring proper and adequate number of responses from both sides can prevent the dyadic research from being carried out (Duffy and Fearne, 2004). Furthermore, it is not easy to have converging views among participants in relationships (Heide and Stump, 1995). The issues about analysis and interpretation can also be caused by dyadic research (Blair and Zinkhan, 2006). The imbalance of power between parties can make dyadic research more difficult. Duffy and Fearne (2004) gave an example of the food industry in which superior power is on the side of buyers rather than suppliers who are unwilling to reveal their customers because of their weak power over buyers. Because buyers (shippers) can easily change suppliers (shipping companies) in a highly competitive industry such as logistics, customers (shippers) are typically regarded as having more power in supplier-customer relationships (Golicic, 2007). It is true that "most collaborative partners are not equal in terms of clout or bargaining power" (Min *et al.*, 2005, p.243). Hence, one side of the relationship has typically been examined by relationship research (Golicic and Mentzer, 2006). This is why this study features one-sided research.

1.6.2 Why South Korea is chosen for this research

The reasons for choosing South Korea can be described in several ways. First of all, South Korea has long pursued export-oriented economic development strategies (Cline, 2004; Onaran and Stockhammer, 2005). In particular, Korea has executed economic growth policies through trade expansion (MOTIE, 2002). Since 99.7 percent of Korea's trade travels by sea, the international shipping and port sector have served as the spearhead of the country's economic development (MOF, 2016b). In addition, the Ministry of Oceans and Fisheries was re-established in 2013, which symbolises the South Korean government's commitment to create a new growth engine from the sea (MOF, 2015).

South Korea is considered as an advanced shipping country as measured by the amount of ship's space effectively controlled by the country and the annual container volume throughput of the country's ports. The nation has about 79 million dead weight tonnage vessels which ranks South Korea seventh globally in 2016. The country also has excellent infrastructure such as Busan Port – Busan is a city ranked sixth in the world in terms of container volume throughput in 2015. Besides, six liner shipping companies of the country are included in leading 50 shipping lines in the world as of July 2016 (UNCTAD, 2016).

With regard to shippers, South Korea has large companies such as Samsung, LG, Hyundai, and POSCO. The country is a sixth steel producer and a fifth steel consumer and correspondingly fourth importer of iron ore and fifth consumer of coal in the world (UNCTAD, 2016).

In short, the shipping industry has played an important role in the economy of South Korea. Hence, South Korea is deemed to be an adequate country for a researcher to study the relationship between shippers and shipping companies. Furthermore, recently, South Korea has stressed the importance of a cooperative and collaborative relationship between shipping companies and shippers as a new growth engine for its shipping industry in the fiercely competitive business environment of the world shipping economy.

As of late May 2016, there are 183 ocean-going and 723 coastal shipping companies in South Korea (MOF, 2016a). The total Gross Tonnage (GT) and number of vessels are shown in Table 1-1. The number of coastal shipping companies is four times as many as ocean-going companies whereas total GT of coastal shipping companies is just 3% of that of the sea-going companies. Average GT and number of vessels per company in the sea-going shipping are

344,181 GT and 8.7, whereas those in the coastal shipping are 2,645 GT and 2.9 respectively. It is ascertained that compared to the ocean-going shipping, the coastal shipping is mostly comprised of small businesses.

Table 1-1 Present condition of the shipping industry in South Korea

	Number of companies	%	Total GT	%	Number of vessels	%
Ocean-going	183	20.2	62,985,058	97.1	1,596	43.6
Coastal	723	79.8	1,912,111	2.9	2,063	56.4
Total	906	100	64,897,169	100	3,659	100

Source: Adapted from MOF (2016a)

Table 1-2 below shows the current state of the ocean-going shipping industry in South Korea. Through the analysis of MOF's internal data, 50 companies operating simultaneously several other types of vessels are identified. By including these 50 companies, the total number of the ocean-going shipping companies in South Korea is increased to 251 although the total GT and total number of vessels remain equal. Bulk carriers form the largest group of ocean-going ships in terms of number of companies, total GT and total number of vessels. Although the number of companies operating container ships is just 7%, the companies have the second largest GTs and number of vessels in the ocean-going shipping industry. In addition, tugs and barges comprise the smallest ratio in the ocean-going shipping in terms of the three criteria.

Table 1-2 Present state of ocean-going shipping in South Korea

	Number of companies	%	Total GT	%	Number of vessels	%
Container ship	17	7	13,570,859	22	311	19
Bulk carrier	78	31	34,133,931	54	605	38
Crude oil tanker	11	4	7,028,877	11	60	4
LPG/LNG tanker	15	6	2,917,013	5	71	4
Product/ chemical carrier	54	22	3,213,529	5	291	18
General cargo vessel	58	23	1,785,754	3	184	12
Tug and barge	8	3	83,532	0	27	2
Others	10	4	251,563	0	47	3
Total	251	100	62,985,058	100	1,596	100

Source: Adapted from MOF (2016a)

Table 1-3 below represents the current state of Korea's coastal shipping industry. If 81 companies which operate concurrently other types of vessels are included, the number of companies increases to 811. In the coastal shipping industry, there are no companies operating container ships which account for the second largest ratio in the ocean-going shipping in terms of total GT and total number of vessels. Table 1-3 also indicates especially that tugs and barges hold the number one position in terms of the classification criteria whereas this type of vessel occupies the least proportion in the ocean-going shipping. Bulk carriers form the second largest type of vessel operated by coastal shipping companies. Crude oil tankers and LPG/LNG tankers show very small proportions whereas product/chemical carriers represent a slightly higher ratio.

Table 1-3 Current condition of coastal shipping in South Korea

	Number of companies	%	Total GT	%	Total number of vessels	%
Container ship	-	0	-	0	-	0
Bulk carrier	152	19	388,961	20	202	10
Crude oil tanker	4	0	2,356	0	5	0
LPG/LNG tanker	9	1	22,672	1	12	1
Product/ chemical carrier	122	15	263,132	14	231	11
General cargo vessel	37	5	141,173	7	59	3
Tug and barge	388	48	1,061,796	56	1,437	70
Others	99	12	32,021	2	117	6
Total	811	100	1,912,111	100	2,063	100

Source: Adapted from MOF (2016a)

1.7 Research structure

This thesis is organised as follows.

Chapter Two first reviews literature related to theories supportive of cooperation or collaboration. The review of cooperation or collaboration in the context of SCM, logistics, maritime logistics and shipping is followed. In particular, who can be a shipper is addressed. Finally, issues associated with index are examined. Through related literature review, research gap is identified in more detail.

Differentiation of cooperation and collaboration is first attempted in Chapter Three. The components of cooperation and collaboration are identified. The sub-constructs and parent concepts of cooperation and collaboration are operationally defined. Based on the construction of cooperation and collaboration, several hypotheses representing relationships among the sub-constructs are established. Additionally, a few hypotheses related to types of shipping registered, vessel types, and contract period are suggested.

Chapter Four deals with research methodology. The philosophical and methodological stances of this study and the research design are presented. Methods, namely how to collect and analyse data, are addressed. Quantitative techniques such as EFA, CFA1, path analysis and MANOVA as methods to analyse data are examined.

Chapter Five shows how the instrument of this study is developed. The process of generating items as well as general description of content analysis is provided. The procedures of Q-sort which is conducted for scale development and of pilot test for the completion of the instrument development are also explained.

Descriptive analysis of data is addressed in Chapter Six. Types of vessel are reclassified for further analyses. Response rate is calculated. Collected data are screened in terms of an outlier, a missing value, and an unengaged response. Non-response bias is tested as well. Overall statistics for items as well as survey response profile are suggested.

Chapter Seven, which is closely related to Chapter Four, provides the result of empirical analyses. After testing for major statistical assumptions such as normality and homogeneity of variance, the EFA reveals the final items of cooperation and collaboration for further empirical analyses. Through SEM, the reliability and validity of constructs are examined and structural model for collaboration is tested. Finally, the calculation and comparison of CCSIs through MANOVA are conducted.

In the final chapter, research findings describing the objectives of this research and outcomes of hypotheses tests are synthesised. The contributions of this study to theories and academic development are addressed and implications of this research in terms of industry and policy are suggested. Finally, limitations of this study are examined and recommendations for future research are made.

1.8 Summary

This chapter introduced the reasoning behind the development of CCSIs between shippers and shipping companies as a case study of cooperation and collaboration in SCs through the brief examination of the research background, gap, scope, objectives and methodology. The rationale for the research and the choice of South Korea were suggested. As a step for the development of CCSIs, the next chapter reviews theories underlying inter-firm cooperation and collaboration. How cooperation and collaboration has been studied in the context of SCM, logistics and shipping is examined. To achieve this, general ideas concerning SCM, logistics, shipping and shippers are concurrently addressed. In addition, for indexing of the extent of inter-firm cooperation and collaboration, index development procedure and related indices are reviewed.

Chapter 2 Literature review

This study focuses on logistics, especially maritime logistics among functional boundaries of SCM and cooperation or collaboration among key components of SCM. Hence, the cooperative and collaborative relationship between shippers and shipping companies as a case of research regarding collaboration in SCs is understood in the context of SCM and logistics as well as on the basis of theories concerning cooperation and collaboration.

Theories underpinning cooperation and collaboration are first considered in Section One. The relationship between SCM and logistics and the meaning of collaboration in SCM and logistics are reviewed in Section Two. The section also examines the significance of maritime logistics and transport and how cooperation or collaboration has been discussed in maritime logistics and transport literature. Although shippers, the users of maritime transportation services, have obtained relatively less attention in research (Fransoo and Lee, 2013), overall review of shippers is also examined. This is because one of objectives of this study is to reveal the attitude of shippers towards shipping companies. Such issues as who consists of shippers and how shippers can vary are also addressed in Section Two. Finally, an outline and issues of index are suggested and some indices considered to be related to this research are introduced in Section Three. Through this chapter, literature gap - there is no literature directly examining and measuring the cooperative or collaborative relationship among the SC members as a case study of collaboration in SCs - is identified in more detail.

2.1 Theories to underpin inter-firm cooperation and collaboration

Although cooperative relationships do not have a clear definition, partnerships, alliances, joint ventures, network organisations, franchises, license agreements, contractual relationships, service agreements, and administered relationships can be the examples of cooperative relationships (Golicic *et al.*, 2003). A shipping company essentially gains benefits from delivery of freights fulfilling the demand of a shipper. Therefore, in the shipping company's side, how much the relationship with the shipper is cooperative and collaborative is very important. A shipper also needs to establish cooperative and collaborative relationship with a shipping company in the respect of suitable and stable delivery of its products or goods. In this regard, the theories underpinning the cooperation and collaboration need to be examined.

Cao and Zhang (2010) examine SCC based on four perspectives; transaction cost theory (TCT), resource based theory (RBT), relational theory (RT), and extended resource based theory. Because only one theory cannot entirely explain the alliances, Sambasivan *et al.* (2013) make use of various theories such as TCT, RBT, contingency theory (CT), social exchange theory (SET), and personal relationship theory to elucidate strategic alliances. Kim *et al.* (2010) propose three theories such as resource dependency theory (RDT), TCT, and social capital theory (SCT) to reveal inter-organisational cooperation. Hence, the theories can again be organised such as TCT, RBT, RT, RDT, CT, SET, and SCT. As there is shortage of consensus on how to name a set of studies as theory or perspective or view or approach (Acedo *et al.*, 2006), terminology of theory is preferred in this research.

2.1.1 Transaction cost theory

How to decide an organisational boundary can be explained by TCT (Geyskens *et al.*, 2006). The starting point of the theory is *The Nature of the Firm* of Coase (1937) which argued that transaction cost mainly settles governance structures; market or hierarchy. Three dimensions of transactions such as asset specificity, uncertainty, and transaction frequency were developed to measure transaction costs (Williamson, 1975). According to Geyskens *et al.* (2006), transaction-specific assets imply the assets geared towards a certain transaction and a safeguarding problem arising from the assets can be solved by vertical integration. Environmental uncertainty brings about an adaptation problem which can be dealt with by hierarchy. If transaction frequency is higher, the possibility of hierarchical governance is higher. The transaction costs can arise by those dimensions and lead to market failure; the hierarchy instead of market governance can be chosen (Williamson, 1975; 1985). The primary question of TCT is which transaction between in a firm (hierarchy) and in a market is more efficient (Geyskens *et al.*, 2006).

Although the TCT is originally based on the dichotomy (market and hierarchy), recently researchers have focused on an alternative to hierarchy such as relational governance (alliance) when market failure appears (Geyskens *et al.*, 2006). The necessity of cooperation and collaboration as the third alternative of a transaction is based on the extended and recent TCT (Kim *et al.*, 2010).

Governance of transaction can be classified into (spot) markets, long-term contracts (hybrids) and hierarchies. Hybrids transaction such as long-term contracts is particularly related to SCM literature (Williamson, 2005; 2008). The TCT “explains that inter-firm cooperation can overcome the limitations of restricted rationality, secure economic efficiency with reduced transaction costs, and realise transaction stability from opportunistic threats” (Kim *et al.*, 2010, p.864). Networks also have joined the dichotomy and might be regarded as the replacement of both markets and hierarchies (Roe, 2013). Stating that hierarchies use power and markets use prices as the method of exchange, Kjaer (2004) suggests the comparison among market, hierarchies and network in terms of governance as Table 2-1 below.

Table 2-1 Comparing market, hierarchies and network models of governance

	Markets	Hierarchies	Networks
Basis of relationships	Contract and property rights	Employment relationship	Resources exchange
Degree of dependence	Independent	Dependent	Interdependent
Medium of exchange	Prices	Authority	Trust
Means of conflict resolution and coordination	Haggling and the courts	Rules and commands	Diplomacy
Culture	Competition	Subordination	Reciprocity

Source: Kjaer (2004, p.42), taken from *Rhodes (1999) in Stoker (ed.) (1999)*

Shipping lines and terminal operators can be considered as cost minimising actors from TCT (Franc and Van der Horst, 2010). With regard to shipping services, Peter and Olivier (2005) pay more attention to network using the TCT. Through reviewing car carriage services of Japan and Europe, they reveal that although there is traditionally an arm’s-length arrangement (market) between carriers and shippers, high levels of vertical integration might exist because of asset specificity in the car carriage service. They identify that there are four types of inter-firm relationships such as market (tramp services), quasi-market (liner services), network-based arrangement (longer-term agreement) and hierarchy or vertical integration exist in the market. According to them, temporary market-based arrangements are favoured by European shippers, whereas stability of relationships with carriers through network-based arrangements or vertical integration is more chosen by Japanese shippers.

Cooperative and collaborative relationship between SC members can reduce the transaction costs and can increase transaction stability by lessening the opportunistic behaviour of partners.

2.1.2 Resource based theory

RBT was developed by authors such as Edith Penrose, Rubin, Wernerfelt, Prahalad and Hamel, and Jay Barney (Karia, 2011). RBT regards a firm as a collection of different resources or as a resources bundle (Penrose, 1959; Wernerfelt, 1984; Barney, 1991). In this sense, resources of a firm are the analytic unit and the focus of RBT is on the relation between resources and its performance (Franc and Van der Horst, 2010). The application of the bundle of resources of a firm consists of the basis of a competitive advantage of the firm (Wernerfelt, 1984). A short-term competitive advantage and enhanced performance of a firm could be obtained by valuable and rare resources whereas long-term advantages of a firm could be acquired by inimitable and non-substitutable resources (Barney, 1991). Firms are heterogeneous from other firms with regard to resources and capabilities which belong to each firm and the idiosyncratic resources of a firm are determinants of its success (Karia, 2011).

RBT focused on those resources and capabilities within the firm as a source of competitive advantage (Dyer and Singh, 1998). The RBT has regenerated interest in the significance of the individual firm, not the industry (Panayides and Cullinane, 2002). “Resources as a stock of available factors owned or controlled by the firm; and capabilities as the firm’s capacity to deploy resources (tangible or intangible), in combination, using organisational processes to effect a desired end” (Amit and Schoemaker, 1993, p.35). Furthermore, resources are different from capabilities in that resources imply having while capabilities are doing (Olavarrieta and Ellinger, 1997).

Assembling, cooperation and coordination of resources including other firms’ signify capabilities which produce more productivity and performance (Karia, 2011). Mentzer *et al.* (2004) categorised logistics resources into tangible resources (e.g. raw materials, plants, equipment, and logistics networks) and intangible resources (e.g. relationships, culture, logistics expertise, and customer loyalty). Yang *et al.* (2009) also divided resources of container shipping companies into tangible resources, viz. vessels, equipment, plants, and information system and intangible resources, viz. skills, corporate reputation, and relationship network.

In this regard, RT is complementary to RBT (Dyer and Singh, 1998). RT can be regarded as “the application of the RBT to inter-organisational relations” (Acedo *et al.*, 2006). The RBT finds the origin of competitive advantage from the resources which are possessed within the firm whereas RT stresses that the competitive advantage can be acquired by inter-firms dyad or network (Dyer and Singh, 1998). The suggestion of RT is that mutual sharing of valuable know-how is systematically accomplished between suppliers and buyers and in return relationship specific investments are made for rents which can only be engendered by joint working between them (Cousins *et al.*, 2006). The relational rents are an asset of dyad or network and may arise from characteristic inter-firm combinations. The competitive advantage of a partnership can be generated through the effective governance mechanisms which reduce transaction costs as well as through the exchange of or the investment in idiosyncratic assets such as knowledge, resources and capabilities between the partners (Dyer and Singh, 1998).

Shipping lines and terminal operators can be considered as value creating actors utilising strategic resources from RBT (Franc and Van der Horst, 2010).

If resources, especially intangible resources or capabilities could extend to include a cooperative and collaborative relationship network with other firms, RBT could be the theoretical basis of cooperation and collaboration. In this context, resource sharing between SC members can produce competitive advantage and more performance. Resource sharing can be adopted as a concept showing a cooperative and collaborative relationship between a shipping company and a shipper.

2.1.3 Resource dependence theory

According to Hillman *et al.* (2009), RDT was first advocated in *The External Control of Organisations: A Resource Dependence Perspective* written by Pfeffer and Salancik (1978). Attempts to secure necessary resources from the market arise because most firms cannot internally obtain all resources and at this time bilateral relationships emerge (Reid *et al.*, 2001).

RDT has something in common with RBT in that both theories recommend SCs to collaborate for better performance. The essential premise of RDT is that only with cooperation and support from other SC partners, SCs can respond to market demand (Ramanathan and Gunasekaran, 2014). Antecedents for cooperation between firms which depend on their partners to acquire necessary resources were identified through studies (Kumar *et al.*, 1995b). As corporations are affected by and dependent on the external environment, actions to reduce environmental uncertainty are taken by managers (Hillman *et al.*, 2009). The actions can contain mergers/vertical integration, joint ventures and other inter-organisational relationships (e.g. strategic alliance), boards of directors, political action and executive succession (Pfeffer and Salancik, 1978).

RDT consists of the following three assumptions (Ulrich and Barney, 1984). Internal and external coalitions compose organisations. Acquiring scarce and valuable resources essential for survival is subject to uncertain environment. Organisations desire to achieve the power, the control over resources and to minimise their dependence on the other organisations or to maximise the dependence of the other organisations on themselves.

Hence, the arguments of RDT can be summarised as follows (O'Toole, 1997). Firms exchange between each other to acquire necessary resources. One possible solution to gain or produce the necessary resource is an internal hierarchy. However, this choice would be very risky and inefficient in a volatile and unpredictable global business environment. Therefore, it is better to gain access to the resources of other firms. However, this could bring about a control problem. “The loss of autonomy is a central concern of resource-dependency school” (p.35). In RDT, it is presumed that uncertainty leads to cooperation between firms and dependency on other firms. Dependency is not regarded as positive and should be evaded if possible. The contribution of RDT is that a relationship also can be regarded as a kind of resource. “It is a resource because much of what goes on in a relationship can generate returns to the parties” (p.37). Therefore, RDT can contribute to the relationship study.

In the shipping industry, most shippers cannot usually own shipping resources such as vessels, terminals and delivery know-how. Shipping assets are normally capital-intensive and most shippers without the capacity to acquire proper shipping assets have no choice but to depend on shipping companies' resources. Therefore, in the sight of a shipper, well-established cooperative and collaborative relationship with a shipping company is also essential. However, according to RDT, there is another possibility that the shipper would be concerned about too high dependency on the shipping company and would attempt to find out how to reduce the dependency.

2.1.4 Contingency theory

CT is related to organisation theory and design (Betts, 2003). The emphasis of CT moved to an organisation's environment (Borgatti and Li, 2009). The principal concept of CT is that the best way how an organisation is organised depends on the environment where the organisation operates (Betts, 2003). According to Galbraith (1973), fundamentally, CT assumes that one best way to organise cannot be possible and any way of organising has its own effectiveness.

It is the key concept of CT that the achievement of high performances of an organisation can vary with the fit between its structure and contextual variables (Taylor and Taylor, 2013). When a match between the environment and the organisation results in high performance, the match is named as 'fit' namely "the better the fit, the higher the performance" (Betts, 2003, p.123). In this vein, environment can be called a variable which is moderating the relationship between organisation and performance (Van de Ven *et al.*, 2013).

CT also explores how contingent factors such as technology, culture, and external environment affect an organisation's structure and function (Islam and Hu, 2012). Some authors find contingency factors such as national culture, strategic context, and firm size (Taylor and Taylor, 2013). Betts (2003) points out the primary contingency factors as environment, technology, age and size. Thanks to unpredictability and rapid change of both organisations and their environments, today's organisations are trying to design for innovation and to find out the ways to enhance the innovation within and outside of the organisations (Van de Ven *et al.*, 2013). Therefore, the cooperation and collaboration between companies can be explained as one way to enhance the ‘fit’ with a fast-changing environment around the companies.

2.1.5 Social exchange theory

Only recently the holistic approach of SET is introduced to SC relationships (Narasimhan *et al.*, 2009). According to SET, firms interplay with other firms for compensation or for the expectation of compensation (Homans, 1958; Emerson, 1976). One of SET propositions is that more frequent rewards for a particular action of a member to an exchange increase the possibility that the same action is repeatedly conducted by the member (Griffith *et al.*, 2006). SET explores how interactions of the actors in an exchange process are influenced by rewards and costs (Molm, 1991). The difference between the rewards and cost of interaction determines attitudes and behaviours (Griffith *et al.*, 2006). Once the actors compare between the rewards and costs of an exchange procedure, they decide to participate in the exchange and make relationships which can maximise benefits and minimise costs (Nunkoo and Ramkissoon, 2012).

Bachmann (2001) indicated that a compound of power and trust are basic constructs of social exchange relationships. Emerson (1976) pointed out power and justice as the most important concepts in this theory.

Power is defined as “the ability of one social actor to influence another social actor” and is inevitably related to dependence. More dependence on a party increases more power of the party over the other party. Justice, especially distributive justice, is referred to as “the perceived fairness with the decision outcome”. When an exchange partner recognises that distributions are appropriate and rational, the partner regards the exchange or the relationship as fair and beneficial (Narasimhan *et al.*, 2009, pp.367-377). The recognition leads to a high sustainability of the relationship (Morgan and Hunt, 1994).

Social exchange literature also has studied commitment and trust extensively (Morgan and Hunt, 1994). Trust can reduce conflicts and support effective collaboration and partnership between social actors (Nunkoo and Ramkissoon, 2012). Trust between the actors can persist and extend social exchange (Zafirovski, 2005).

The characteristics of the SET can be summarised as follows (O'Toole, 1997). SET focuses on the exchange relationships or the dyad/network and recognises the self-interest which could be best obtained through equitable behaviour of partners and in the best interests of partnership. In SET, trust and commitment are focal elements and regulate the impact of power and verify the fairness of the exchange relationship.

In this context of SET, fairness, trust and commitment can be the constructs representing or measuring a cooperative and collaborative relationship between SC members.

2.1.6 Social capital theory

Across a wide range of social science disciplines including organisation studies, social capital has gained its popularity (Adler and Kwon, 2002). The original theorists, Bourdien (1977) and Coleman (1988) developed SCT (Martin, 2006). The definition of social capital has been differentiated by the emphasis on external and internal relations or both relations (Adler and Kwon, 2002). From the view of emphasising the external relations, social capital can be defined as "the number of people who can be expected to provide support and the resources those people have at their disposal" (Boxman *et al.*, 1991, p.52). If the internal relations are stressed, social capital implies a set of informal values or norms with which members of a group share and which facilitate cooperation among them (Fukuyama, 1997). In the eclectic position, social capital can be defined as "the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit. Social capital thus comprises both the network and the assets that may be mobilised through that network" (Nahapiet and Ghoshal, 1998, p.243). Similarly, social capital implies "networks together with shared norms, values and understandings that facilitate co-operation within or among groups" (OECD, 2001, p.41).

The essence of social capital is "goodwill" which others have towards us (Adler and Kwon, 2002). Networks of relationships form a precious resource for social activities and allow information, knowledge and ideas to be accessed and exchanged both formally and informally (Martin, 2006). Cooperative behaviour can be encouraged by social capital and thereby the development of new forms of innovative association and organisations can be facilitated (Putnam, 1993; Fukuyama, 1995). The likeliness of opportunism and correspondingly expensive monitoring processes can be diminished by high levels of trust inhered in social capital, which consequently reduces the transaction costs (Putnam, 1993). In other words, social capital can reduce economic transaction costs through cooperation and trust within inter- or intra-firm networks and can enhance cooperative behaviour and trust (Martin, 2006).

Because social capital is a kind of resource which actors can utilise (Adler and Kwon, 2002), as far as highlighting the competitive advantage of a firm goes, SCT can be consistent with the RBT (Nahapiet and Ghoshal, 1998).

Cooperative relationships like trust, goal consistency, and reciprocity between firms are identified through studies of SCT (Kim *et al.*, 2010). To sum up, information sharing, goal consistency, support, reciprocity, and trust can be utilised as factors representing a cooperative and collaborative relationship between SC members.

In this section, six theories explaining why firms or organisations cooperate and collaborate with each other and what constitutes cooperation and collaboration were examined. The next section reviews how the concepts have been studied in the context of SCM, logistics, maritime logistics and shipping. For this, the examination of general ideas regarding SC, SCM, logistics, maritime logistics, and shippers are presented.

2.2 Cooperation and collaboration in supply chain management, logistics, maritime logistics and shipping

2.2.1 Supply chain management, logistics, and collaboration

Ever since the early 1970s, SC or SCM have been developed to combine major business processes through inter-firm cooperation as well as inter-functional coordination for better customer service and competitiveness (Min and Mentzer, 2004). Albeit, it is true that there is still the lack of SCM definition consensus (Gibson *et al.*, 2005) which has made SCM a very extensive field (Ellram and Cooper, 2014).

With regard to the scope of SC, Steven's (1989) understanding is the most widely adopted in the literature (Cooper *et al.*, 1997). SC is the connection of a series of activities in terms of planning, coordinating and controlling of material, parts and finished goods from suppliers to end users (Stevens, 1989). To put it another way, SC can be considered a set of firms included in two-way flows of products, services, information and finances (La Londe and Masters, 1994; Mentzer *et al.*, 2001). SCM is not only new terminology for proper implementation of logistics across organisations but also can embrace all business operations across intra and inter organisations (Cooper *et al.*, 1997). SCM is sometimes construed as only integrated logistics (Tyndall *et al.*, 1998), a management process (La Londe, 1997), and a managerial philosophy and vertical integration of firms (Cooper and Ellram, 1993). However, it is reasonable to consider that all the conceptualisations should be included in SCM (Mentzer *et al.*, 2001).

The boundaries of SC are beyond transport and physical distribution (Stevens, 1989). The functional boundary of SCM involves almost every function of a firm such as manufacturing, purchasing, marketing, promotion, sales, research and development, product design, and total systems and value analysis as well as logistics (Mentzer *et al.*, 2000b; Mentzer *et al.*, 2001). In SCM, functional integration is extended to all the companies in a SCM beyond only single firm (Cooper and Ellram, 1993; Cooper *et al.*, 1997). Hence, the members of a SC are not limited to a supplier/vendor, a manufacturer, and a distributor but open to all firms which have relationships with the upstream and downstream flows (Mentzer *et al.*, 2001; Sahin and Robinson, 2002). Correspondingly, multiple relationships that companies may experience within a SC exist (Golicic, 2007).

All individual members of a SCM intend to improve the competitiveness of the SC (Cooper and Ellram, 1993; Bowersox *et al.*, 1996). That is, SCM focuses on the competition of between SCs, not between individual firms (Poirier, 1999; Christopher, 2016). “To be an effective competitor in the global economy requires one to be a trusted co-operator in some network. Effective cooperation within a network promotes effective competition among networks” (Morgan and Hunt, 1994, pp.20, 26). Efficiency and effectiveness in a SC are enhanced by continuous relationships among the SC members (Sahin and Robinson, 2002; Griffith *et al.*, 2006). Successful SCM requires successful development and management of relationships among firms in the SC (Golicic, 2007).

Many authors have considered agreement on the vision and customer satisfaction, mutual sharing of information, risks and rewards, cooperation, integration of processes, long-term relationships, and SC leadership as the primary elements of SCM (Min and Mentzer, 2004). Coordination and collaboration as well as integration across organisations and throughout SC are included in SCM (Stank *et al.*, 2001; Gimenez and Ventura, 2005).

Cooperation or collaboration is also addressed as essential concepts of SCI which is a part of SCM (Nassirnia and Robinson, 2013). SCI is defined as “a process of interaction and collaboration in which manufacturing, purchasing and logistics work together in a cooperative manner to arrive at mutually acceptable outcomes for their organisations" (Pagell, 2004, p.460). Accordingly, constructs such as cooperation, coordination, interaction, and collaboration can be encompassed in SCI (O'Leary-Kelly and Flores, 2002). Integration along SC has obtained interests of logistics managers and researchers as a source of competitive advantage (Gimenez and Ventura, 2005). However, little consensus exists on how to define the SCI and how to capture the essential elements of SCI, a relatively new field of study (Alfalla-Luque *et al.*, 2013; Nassirnia and Robinson, 2013).

Logistics has been considered to develop from physical distribution and mainly to relate to inland physical transport and distribution (Panayides, 2006). Values are added by logistics (Stank *et al.*, 2001) through making the delivery of products in the appropriate place at the right time (Panayides, 2006). The advent of SCM made a carrier be transformed to an essential component of SC service performance from just a product dispenser or distributor (Panayides and Cullinane, 2002). A carrier functions as a SC integrator, a disseminator of information and a transport service adviser (Wagner and Frankel, 2000).

In this vein, the relationships between carriers and shippers have been explained in the context of SCM (Crum and Allen, 1997). CSCMP (2017) suggests the following definition of logistics management: "… To varying degrees, the logistics function also includes sourcing and procurement, production planning and scheduling, packaging and assembly, and customer service. Logistics management is an integrating function, which coordinates and optimises all logistics activities, as well as integrates logistics activities with other functions including marketing, sales, manufacturing, finance, and information technology."

Hence, in nearly all SCs, a common supplier and customer relationship can be explained by the relationship between shippers and carriers. The movement of goods in the SC creates multiple shipper-carrier relationships (Golicic, 2007) and in many cases includes maritime activities (Song and Lee, 2009).

In summary, logistics is one of the most fundamental activities in SCM and cooperation or collaboration is one of the most salient concepts in SCM.

2.2.2 Cooperation and collaboration in supply chain management and logistics

Among 69 literature addressing collaboration in SC, the collaboration between manufacturers and their suppliers and between retailers and their suppliers dominates higher proportion (Hudnurkar *et al.*, 2014). Emphasis on consumer goods retailing, computer assembling and automobile manufacturing is mainly put in the majority of literature about SC relationships (Benn Lawson *et al.*, 2006). The measurement of SCC has relatively limited attention in the light of increasing its popularity (Simatupang and Sridharan, 2004). Further, conceptualisation of collaboration has overemphasised process integration although collaboration does not merely imply inter-firm transactions (Cao *et al.*, 2010). Albeit, some distinguished papers examining cooperation and collaboration conceptually or empirically in the context of SCM are described below.

Anderson and Narus (1990) support that cooperation between distributor and manufacturer firms can be an antecedent of trust using path analysis. Heide and Miner (1992) identify four factors of cooperation between buyers and suppliers such as flexibility, information exchange, shared problem solving, and restraint in the exertion of power. Ganesan (1994) reveals that long-term relationship between retail buyers and their vendors is determined by trust and dependence through SEM. Morgan and Hunt (1994) investigate the antecedents and consequences of trust and commitment between tire retailers and suppliers adopting SEM.

Bove and Johnson (2001) argue that trust and commitment between a customer/buyer and service personnel/provider/seller represent “relationship strength” and exemplified the antecedents of the “relationship strength” as information and cooperation. Barratt (2004) suggests a collaborative culture which is composed of trust, mutuality, information exchange, and openness/communication as an important component of collaboration. Simatupang and Sridharan (2005) measure SCC through three dimensions such as information sharing, decision synchronisation, and incentive alignment and propose a collaboration index between retailers and their suppliers. Min *et al.* (2005) examine SCC through a qualitative approach and develop a conceptual model of SCC. According to them, information sharing, joint planning, joint problem solving, joint performance measurement, and leveraging resources and skills are the principal features of collaboration. Based on SET, Griffith *et al.* (2006) show that procedural and distributive justice has a positive effect on long-term orientation in a SC between suppliers and distributors with CFA1 and path analysis.

Kim *et al.* (2010) suggest the determinants of cooperation such as technical uncertainty, reciprocity, trust through the examination of the relationship between telecommunication service providers and their suppliers. Targeting manufacturing firms and using CFA1, Cao and Zhang (2011) tests the relationships of components composing SCC such as information sharing, collaborative communication and joint knowledge creation. Chen *et al.* (2011) identifies information sharing, quality and availability as antecedents of trust and commitment in a SC consisting of manufacturer, distributor, and supplier. Ramanathan and Gunasekaran (2014) show that success of collaboration depends on collaborative planning, decisions making and execution. Their research targets customers who collaborate with their suppliers in the textile industry and uses SEM method. Kumar and Nath Banerjee (2014) use six dimensions to conceptualise an instrument for measuring SCC and to calculate Supply Chain Collaboration Index (SCCI). Relevant data are collected from SC members in diverse industries and the instrument is tested with Partial Least Squares.

Cooperation and collaboration between shippers and carriers have also been studied. Key components of an effective logistics partnership have emerged in literature since 1989 (Gibson *et al.*, 2002). However, few studies reviewing the differences and outcomes of the relationship between shippers and carriers exist and even most of extant studies are anecdotal (Zsidisin *et al.*, 2007).

Kleinsorge *et al.* (1991) argue shippers and carriers start to move towards long-term relationships owing to cooperative atmosphere or deregulation such as the Motor Carrier Act of 1980 and utilise Data Envelopment Analysis (DEA) for the monitoring of long-term performance. Gardner *et al.* (1994) identify the five components of *win/win partnership relationships* such as “relationship extendedness” (loyalty and long-term expectations) and sharing of benefits and burdens among the relationships between shippers and carriers/warehousers using CFA1 and case study.

Stank *et al.* (2001) find that internal collaboration affects directly logistical service performance and external collaboration influences the performance indirectly through its direct effect on internal collaboration. They design the sample comprised of manufacturers, distributors, and retailers and use SEM to reveal the relationship between internal/external collaboration and logistical performance. Gibson *et al.* (2002) extract ingredients of successful partnership between carriers and shippers such as trust, effectiveness, shared risk and reward, and information sharing. They compare the understanding difference between shippers and carriers about the critical factors in shipper-carrier partnership. Zsidisin *et al.* (2007) show that closer relationships between shippers and carriers such as communication, trust and mutual dependence have significant influence on the willingness of carriers to commit assets to shippers through qualitative and quantitative methods. Golicic (2007) utilises SEM to test the “relationship strength” such as trust, commitment, dependence and its perceptive difference between shippers and third party logistics providers in logistics industry. They find significant differences between shippers and carriers in terms of trust and commitment. Fugate *et al.* (2009), through interview with industrial experts, argue that environmental changes and capacity constraints such as regulation on working hour of lorry drivers trigger more balanced power between shippers and inland carriers which subsequently leads shippers to have more collaborative relationships with the carriers.

2.2.3 Maritime logistics, shipping and shippers

Maritime transportation is one of the main composites of logistics and plays a bridge role for linking all participants in logistics through ocean carriage of cargoes. Within the context of logistics, maritime transportation can evolve into maritime logistics. Maritime logistics refers to the process where the flows of commodities and information involved in the ocean transportation are planned, conducted and managed. Maritime logistics encompasses three key players such as shipping, port/terminal operating and freight forwarding (Lee *et al.*, 2012, pp.10-11). A maritime logistics concept was derived from the demand for integrated ocean carriage (Panayides, 2006). Maritime logistics can be referred to as an extended concept of maritime transportation in that other logistics services such as storage, inventory management, distribution, and inland connection as well as seagoing shipping are contained in maritime logistics (Lee *et al.*, 2012). Albeit, the establishment of the definition, scope and roles in global SC of maritime logistics is still in progress (Song and Lee, 2009).

"Maritime transport is the backbone of globalisation and lies at the heart of cross-border transport networks that support SCs and enable international trade" (UNCTAD, 2016). Shipping is involved in an international logistics supply industry where suppliers (shipping companies) are providing differentiated services (Gwilliam, 1993). Seagoing shipping plays an essential role in global SC in that as business operations are being outsourced more globally, much more resources and products are depending on maritime transport (Lam, 2011). As the production and distribution of shippers have been implemented more globally, the need for efficient international logistics of shippers has increased

(Frémont, 2009). Shipping companies connect manufacturing sources in developing countries to the consumer markets in the developed countries (Fransoo and Lee, 2013). The scale and scope of global freight distribution have been changed by container shipping (Notteboom and Rodrigue, 2008). In other words, global outsourcing and offshoring of manufacture have direct effects on the type of products shipped (Feenstra, 1998) and have led to the extension of shippers. The total seaborne trade volumes of 2015 consist of 17% of container, 54% of dry bulk, and 29% of tanker trade such as crude oil, petroleum products and gas (UNCTAD, 2016).

The types of vessels according to traffic can be grouped into liners, tramps and specialised vessels. Liners, namely containers refer to vessels plying on a regular basis between ports at fixed prices whereas tramps do not have a regular operating schedule (Branch, 2007). Liner shipping operations are analogous to a bus line service and tramp shipping a taxi service (Windeck and Stadtler, 2011). “The bulk shipping industry is built around minimising unit cost, while the liner shipping industry is more concerned with speed, reliability and quality of service” (Stopford, 2009, p.78). The tramp shipping industry is composed of dry bulk carriers and oil tankers (Thai *et al.*, 2014). Thus, broadly speaking, the type of vessels can be divided into a container, a bulk, a tanker and others.

The container SC includes various parties in terms of logistics, transaction and oversight layers such as government (Willis and Ortiz, 2004). More specifically, the parties in container SC include buyers and suppliers, distributors, logistics service providers, freight forwarders, Non-Vessel Operating Common Carriers (NVOCCs), shipping companies, terminal operators, and hinterland transport operators (Lam, 2011; Fransoo and Lee, 2013). The coordination among the multiple players is very important for overall performance of the SC (Fransoo and Lee, 2013). As users of logistics services, shippers incur the prices or logistics costs imposed by carriers (Talley and Ng, 2013). A freight forwarder, a specialist for Less than Container Load (LCL) containers, earns most of their revenue from the grouping and de-grouping of goods and managing customer's operations (Frémont, 2009). Ocean carriers contract with terminal operators, hinterland carriers or logistics service providers as well as shippers (Fransoo and Lee, 2013). In North America, shipping lines subcontract with inland transport providers whereas in Europe and Asia, shippers and freight forwarders dominantly contract with inland transport companies (Frémont, 2009; Lin, 2015).

Dry bulk trade constitutes a main component in the SC for metal producers, steel plants, aluminium and agro-food industries (Comtois and Lacoste, 2012). The main five bulk commodities refer to iron ore, coal, grain, bauxite and alumina, and phosphate rock (UNCTAD, 2016).

Shippers, namely cargo owners (Stopford, 2009) or users of transport services can be differ because of the complexity of international transport transactions (UNCTAD, 2016) and according to vessel types. Shippers could contract with ocean shipping lines directly or with a third party such as NVOCCs and logistics service providers to handle their container shipments. The NVOCCs reserve large container spaces of shipping lines and sell the spaces to shippers (Fransoo and Lee, 2013). In terms of Full Container Load (FCL) cargo, both freight forwards and shipping lines have direct relationships with shippers (Frémont, 2008). On the contrary, regarding LCL cargo, freight forwarders usually contract with shippers and act as main customers of shipping companies (Frémont, 2009; Lin, 2015). Direct contract between shippers and shipping lines accounts for about 70% in the Asia-North America ocean container route, whereas in the Asia-Europe around 70% of contracts belong to the contract between freight forwarders on behalf of shippers and shipping companies (Fransoo and Lee, 2013). Thus, freight forwarders and NVOCCs function as *de facto* shippers to the shipping lines. Trade agreement terms such as cost insurance freight between sellers and buyers also determine shippers (Lin, 2015). Kent and Stephen Parker (1999) posit exporter and importer as shippers of international containership carriers. Cargo owner’s types are the main factor of determination of shippers. Manufacturers tend to assign all the logistics process to freight forwarders whereas branders and large retailers usually exert their bargaining power and prefer to make separate contracts with freight forwarders and shipping carriers (Lin, 2015).

With regard to bulk carriers and tankers, the companies in the industries such as grain, building materials (cement, steel, and others), mining (iron ore, coal, and others), oil, petroleum and chemicals as well as traders can be shippers of tramp shipping (Thai *et al.*, 2014). Because an important input of aluminium industry is bauxite and steel industries require iron ore and coal as primary resources (Comtois and Lacoste, 2012), companies using the raw materials are one of the main industrial shippers of shipping companies. The fundamental industries such as oil refineries and steel producers sometimes develop their own transport system (Stopford, 2009). Tramp cargo buyers which have their own ports tend to act as shippers and terminal operators (Lin, 2015).

To recapitulate, shippers of shipping companies vary under the several circumstances mentioned above. Exporter and importer, FCL/LCL cargo owners, freight forwarders, NVOCCs, suppliers, manufacturers, distributors, branders, large retailers, and tramp cargo buyers can be considered the main customers of shipping companies.

2.2.4 Cooperation and collaboration in maritime logistics and shipping

Cooperation and collaboration in maritime logistics, as a case study of research regarding collaboration in SCs, is sparsely identified in few studies dealing with the two concepts from the view of SCI. The achievement of operational efficiencies and strategic effectiveness in a SC through collaboration with the SC members is the main purpose of integration (Richey *et al.*, 2010). The objective can be achieved by a SC member's commitment to and coordination with the other SC members (Stank *et al.*, 2001). Coordination and collaboration among SC members are referred to as external integration (Gimenez and Ventura, 2005). However, SCI, a part of SCM, also has obscurity and inconsistency in its definition (Nassirnia and Robinson, 2013). The concept of integration has been at the centre of maritime logistics (Panayides, 2006). On the other hand, even studies on SCI in maritime transport are limited (Lam, 2011) and few studies on the conceptualisations and measurement of the integration across SC have been provided (Panayides, 2006). While coordination among shipping lines has been widely studied, the coordination among companies operating in hinterland has obtained only limited attention (Panayides and Cullinane, 2002; Van Der Horst and De Langen, 2008). Hence, in extant maritime logistics studies, few reliable and generally accepted measurement instruments to measure SCC were found (Seo *et al.*, 2015).

Indicating the limited number of literature on the integration of ports/terminals in SCs, Song and Panayides (2008) suggest empirical evidence as well as six constructs and their measures of port/terminal integration in a SC. The measures include the concepts such as information sharing and trust. Frémont (2008) argue that horizontal integration among shipping lines, terminal operators or forwarding agents/logistics providers exists evidently whereas vertical integration shows a few limited cases. Nassirnia and Robinson (2013) introduce a case study of coal SC in maritime industry. They state that the cooperation of all the SC members and the integration of the SC can lead to the maximisation of benefit and the increment of value of the chain.

Recently, Heaver (2015) and Seo *et al.* (2015) adapts explicitly the concept of collaboration to maritime logistics. Seo *et al.* (2015) measure SCC among maritime container logistics participants such as terminal operators, shipping lines, inland transport companies, freight forwarders, ship management companies, third-party logistics providers. They identify that information sharing, knowledge creation, goal similarity, decision harmonisation and joint SC performance measurement compose major components of SCC in maritime logistics and also that slightly high SCC practices exist. Pointing out that most research in maritime economics has focused on the relationship between port and hinterland functions, Heaver (2015) argues that one of the most widespread phenomena in ports is greater collaboration. Employing the economics of governance and several instances, he reveals that under fierce competition and uncertainties in the globalisation, new collaborative relationships among international logistics parties for the improvement of efficiency have begun to emerge and have been emphasised. The transformation to collaborative relationship from traditionally hostile relationship between maritime logistics organisations is arising (Seo *et al.*, 2015).

This section revealed that in the SCM literature, collaboration between manufacturers and suppliers and between retailers and suppliers has mainly been addressed but the attention on collaboration between shippers and carriers has very limited. In particular, in the literature, components of collaboration have not comprehensively been examined mostly due to focus on operational process perspectives. In addition, the measurement of SCC has gained relatively limited attention and most of the literature concerning collaboration between shippers and carriers is anecdotal. To the best of the author's knowledge, literature conceptualising comprehensively and measuring appropriately cooperation and collaboration between shippers and shipping companies does not exist.

The next section reviews the literature concerning how to develop an index for the measurement of business behaviours. For the development of CCSIs, four indices having similar attributes to CCSIs are introduced.

2.3 Building indices to measure behaviour in business

2.3.1 Outline of index

A number of disciplines including applied and managerial research have increasingly applied a summated scale which was recently developed in academic research. A summated scale signifies a single composite value created by combining several variables with high loadings on a factor and can be utilised as a replacement variable for further analyses (Hair *et al.*, 2014). A composite indicator or an index consists of individual indicators and is also increasingly regarded as a useful tool in policy analysis and public communication (OECD, 2008). The information involved in selected indicators and variables can be synthesised into a single composite indicator (Nardo and Saisana, 2008).

A number of indices are being elaborated by public and private organisations and individual scholars. Indices can be calculated in terms of one country or one institution, facilitating comparison among countries and organisations, and market performance (Bandura, 2008). He identified 178 indices to assess and compare country performance with regard to diverse fields such as competitiveness, governance, human rights, the environment and globalisation. With regard to international maritime transport, 109 indices were categorised into maritime indices (wet, dry and container), economic performance indices, environmental indices and miscellaneous indices (Karamperidis *et al.*, 2013).

They found the indices through content analysis of 10 representative publications in maritime logistics.

2.3.2 Pros and cons about indices

The advantages of using a composite indicator are that the composite indicator which employs multiple variables can reduce the risk of measurement error which can be caused by utilising only one variable and furthermore, the composite indicator can indicate multiple aspects of a concept (Hair *et al.*, 2014). Multidimensional concepts which a single indicator cannot capture can be measured by the composite indicator. The composite indicator can also be useful in checking for trends and in establishing policy priorities (OECD, 2008).

With regard to a collaboration index, measurement of collaboration is needed for the evaluation of performance of the collaboration (Kumar and Nath Banerjee, 2014). The collaboration index can also help the partners find out desirable collaborative practices (Simatupang and Sridharan, 2005). “The index would impart knowledge regarding the depth of collaboration and would assist collaborative alliance in identifying and improving the areas that may need improvement” (Kumar and Nath Banerjee, 2014, p.185). However, the composite indicators are sometimes criticised by the lack of transparency in terms of basic data and methodologies (Nardo and Saisana, 2008).

The pros and cons regarding the use of the composite indicators are summarised in Table 2-2 (Saisana and Tarantola, 2002; OECD, 2008).

Table 2-2 Pros and cons concerning composite indicators

Pros	Cons
Summarise multi-dimensional issues	Provision of misleading policy messages owing to poorly constructed composite indicators
Provision of the big picture	Can draw policy conclusions which are too simplistic
Easier interpretation than trying to find a trend in many separate indicators	Transparency and sound statistical principles are needed for the construction of composite indicators
Facilitation of ranking countries on complex issues	An increase in the quantity of data required
Comparing the performance across countries and identifying countries' progress over time	The choice of indicators and weights can cause political dispute

Source: Adapted from Saisana and Tarantola (2002) and OECD (2008)

Hence, the balance between pros and cons should be considered to create a composite indicator (Nardo and Saisana, 2008).

2.3.3 Steps for developing index

According to Nardo and Saisana (2008, pp.4-13) and OECD (2008, pp.19-35), the ideal sequence of steps which should be complied with when constructing a composite indicator is as follows. The reality or phenomenon to be measured and sub-components which are closely connected with the reality or phenomenon should be defined clearly by a theoretical framework. Constructing credible indicators requires the transparency of the whole procedure. The choice of variables should be based on their relevance, analytical soundness, timeliness and accessibility. The selected variables should be categorised into input, output or process indicators to fit the definition of the composite indicator. When data sets are incomplete, there are techniques to remedy the missing data such as case deletion and single and multiple imputation. Construction of a composite indicator should involve a careful analysis of the nature and properties of the data. Expert opinion and statistical approaches such as Principal Component Analysis (PCA), Common Factor Analysis (CFA2), Cronbach's Alpha, and cluster analysis can be utilised to explore whether a reality or a phenomenon can appropriately be described by the individual indicators or not. The individual variables consisting of composite indicators need to be normalised when the variables have different measurement units. The normalisation can make comparison among the variables possible. There are nine normalisation methods which include ranking, standardisation, and min-max. The contribution of indicators to the composite indicator should be reflected by weights. The weighting methods can largely be divided into three: equal weight, statistical methods and participatory methods. Equal weight does not imply that there are no weights but that the same weights apply to each variable. The statistical methods include PCA, FA, DEA, Benefit of the Doubt (BOD), Unobserved Components Models (UCM). PCA and FA estimate weights of each indicator based on correlation between indicators. In DEA, an efficiency frontier which measures the relative performance of countries is estimated. The application of DEA to the field of composite indicators is BOD. BOD derives the weights from the data and is sensitive to national priorities. UCM is similar to regression analysis. However, the method regards dependent variables as unknown variables to be estimated and the variables do not need to have explicit values. The participatory techniques involve Budget Allocation Processes (BAP), Analytic Hierarchy Processes (AHP) and Conjoint Analysis (CA). In BAP, a budget of N points is allocated to experts and is distributed over individual indicators. When there are 10-12 indicators, the method is optimal.

AHP implies pair-wise comparison of attributes and is the method with less sensitivity to errors of judgement. CA implies the comparison of attributes on different levels and the weight of an indicator can be derived from the weight of a composite indicator. As mentioned above, there are many weighting methods. However, there is no consensus regarding which method to use for deriving weights. Different aggregation rules exist. Computation of a composite index can be obtained by summing up, multiplying or aggregating using non-linear techniques. Linear aggregation is appropriate for indicators with the same measurement unit. The summation of weighted individual indicators is widely utilised in linear aggregation. When individual indicators cannot be compared and have different ratio scales, geometric aggregation methods are useful. A conflict can be caused because different indicators may suit different countries. The Multi-Criteria procedure (MCA) can be used to deal with the conflict occurring in comparisons among countries. The MCA technique is suitable for country ranking, not for an index. Subjective judgement can intervene in the procedure of the construction of composite indicators such as the selection and treatment of data, data normalisation, and weighting and aggregating methods. Hence, subjective judgement can affect the ranking and the message communicated by the composite indicator. Uncertainty Analysis (UA) and Sensitivity Analysis (SA) can be useful to deal with the uncertainties. UA and SA identify how the sources of uncertainty affect the composite indicators' score or a country's rank.

2.3.4 Some indices related to this research

2.3.4.1 Logistics performance index

The World Bank announces international LPI every two years. The index can help each country to identify challenges and opportunities and ameliorate its logistics performance (Jean-François Arvis *et al.*, 2014). They conduct a questionnaire survey targeting global freight forwarders and express carriers with respect to the following six key areas: customs, infrastructure, logistics services, timeliness, international shipments, and tracking and tracing. They use five-point Likert scale and PCA to calculate the LPI. In other words, they multiply normalised scores and component loadings of the six indicators of each country and sum up the scores to produce the LPI of each country. In 2014, the LPI ranks of the UK and South Korea are fourth and 21st respectively.

2.3.4.2 Social progress index (SPI)

Social Progress Imperative recently invented SPI to measure national social and environmental performance. The SPI is independent of GDP however the index can be used as a complement to GDP. The SPI has three dimensions: basic human needs, foundations of wellbeing, and opportunity. Each dimension consists of four components and total indicators representing the 12 components are 52. The indices of South Korea and UK were ranked 29th and 11th respectively among 133 countries (Porter *et al.*, 2015, pp.13-17). The total of weighted scores of its indicators represents each component values. The weights are determined by FA. Each dimension score is computed by the simple average of the four components that constitute the dimension. Finally, the SPI is represented by the simple average of the three dimensions (Stern *et al.*, 2015). The FA for calculation of the weights is supposed to be PCA.

2.3.4.3 Collaboration Index

Simatupang and Sridharan (2005) introduced a collaboration index to measure the level of collaborative practices. A collaboration index is proposed to measure the collaborative practice based on information sharing, decision-synchronisation, and incentive alignment. The index score is simply calculated by the mean score of the three dimensions in the sample (Simatupang and Sridharan, 2005). The rationale for using the mean score is that “it is reasonable to treat responses to the Likert scales as quasi-ratio data” (Gaski and Etzel, 1986, p.73).

2.3.4.4 Supply chain collaboration index

To calculate SCCI, Kumar and Nath Banerjee (2014) use the formula below proposed by Anderson and Fornell (2000) and Fornell *et al.* (1996). The formula was utilised to produce customer satisfaction index. Six dimensions - joint planning for executing schedule, joint planning for increasing market share, market based information sharing, operational resource sharing, joint problem solving and performance measurement, and collaborative culture - are used to calculate SCCI. In the formula, W_i is the weight of measurement item i and $\bar{\mathrm{x}}_i$ is the average value of measurement item i and n is the number of measurement items. AHP technique is used to calculate the weight for each construct (Kumar and Nath Banerjee, 2014).

$$\frac{\sum_{i=1}^{n} w_i \bar{x}_i - \sum_{i=1}^{n} w_i}{n \sum_{i=1}^{n} w_i} \times 100 \qquad [2.1]$$

According to the equation [2.1], the SCCI is 40.44 points which shows somewhat low level of collaboration among various industries (Kumar and Nath Banerjee, 2014).

2.4 Summary

In this chapter, the research gap was identified, namely that literature which conceptualises comprehensively and measures appropriately cooperation and collaboration between shippers and shipping companies does not exist. This gap was identified through examining theories underpinning collaboration and literature analysing collaboration in the context of SCM, logistics, maritime logistics and shipping. Besides, methods whereby the measurement of the concept can be indexed for clearer understanding of the extent of inter-firm collaboration were reviewed along with some examples of similar indices.

In the next chapter, based on the discussion of this chapter, the conceptual model and hypotheses of this research are developed.

Chapter 3 Conceptual model and hypotheses

Since the 1990s, scholars and practitioners have accepted SCC as an important issue (Cao *et al.*, 2009). Collaboration has been viewed as the driving force guiding effective SCM (Ellram and Cooper, 1990). SCM literature can suggest and provide insights into the design and management of relationships among various stakeholders in SCs. The SCM literature offers a framework in which coordination can be addressed (Van Der Horst and De Langen, 2008).

Hence, through a variety of literature reviews, the operational definitions of cooperation and collaboration are made in Section One. In the section, the differentiation between cooperation and collaboration is explored.

Sub-constructs of cooperation and collaboration are identified and their operational definitions are made in Section Two. Such concepts as *fairness*, “relationship strength and extendedness” are introduced.

Section Three addresses the conceptual model of this research. Five hypotheses which are associated with the model are also established in the section. Based on theories, various relationships amongst the sub-constructs are represented by the corresponding five hypotheses.

Section Four deals with the development of additional four hypotheses. The four hypotheses are related to the differences of CCSIs according to shipping registered, vessel types, and contract period.

3.1 The concept and differentiation of cooperation and collaboration

“A wide range of theoretical perspectives results in an equally wide variety of definitions and understandings of the meaning of collaboration. Therefore, collaboration lacks coherence across disciplines” (Thomson *et al.*, 2009, p.23). Different industries show different levels of cooperation and collaboration (Min *et al.*, 2005). Most literature about SCM defines collaboration mixed with cooperation without differentiation between them. Furthermore, different authors define SCC in different ways (Hudnurkar *et al.*, 2014).

Cooperation refers to complementary coordinated activities which SC members implement for superb mutual outcomes which each other anticipates over time (Anderson and Narus, 1990). SCC implies that “two or more chain members working together to create a competitive advantage through sharing information, making joint decisions and sharing benefits which result from greater profitability of satisfying end customer needs than acting alone” (Simatupang and Sridharan, 2005, p.45). Cao and Zhang (2011, p.166) also define SCC as “a partnership process where two or more autonomous firms work closely to plan and execute SC operations towards common goals and mutual benefits”.

“SCC is rooted in a paradigm of collaborative advantage (Kanter, 1994; Dyer, 2000) rather than competitive advantage (Porter, 1985)” (Cao and Zhang, 2011, p.164). SCC is essential for trading partners to develop competitive advantages (Li, 2012; Kumar and Nath Banerjee, 2014). Efficient collaboration can resolve the bullwhip effect arising from distorted information on demand (Li, 2012). The collaborative relationship can also lead to benefits of sharing risks (Kogut, 1988), acquisition of complementary resources (Park *et al.*, 2004), reduced transaction costs and enhanced productivity (Kalwani and Narayandas, 1995) and improved performance (Mentzer *et al.*, 2000a; Cao and Zhang, 2011). To put it another way, SCC as the third alternative to hierarchies and markets helps firms diminish the costs related to opportunism and monitoring that market transactions have inherently and also helps companies avoid the risk of internalisation of an activity which may not be commensurate with their competencies (Cao and Zhang, 2011).

Some authors differentiated the concepts of cooperation, coordination and collaboration. Some standards to distinguish coordination, cooperation, and collaboration were suggested by Golicic *et al.* (2003) and Spekman *et al.* (1998). Golicic *et al.* (2003) state that closeness in relationships is represented by terminology like collaboration, cooperation, and coordination. Collaboration has the highest level of relationship among them. The difference between collaboration and cooperation lies in the extent of trust, commitment, and mutual dependence: cooperation is lacking in trust and less active than collaboration. Spekman *et al.* (1998) introduce a step function to show transition from open market negotiations to cooperation, coordination and collaboration and distinguished their concepts. According to them, cooperation is an incipient relationship like a limited information exchange, or advent of some long-term contracts. Collaboration, the highest level of the relationship, differs from coordination in that collaboration has higher levels of trust and commitment. They also argue that the transition from coordination to collaboration includes free information sharing, solving common problems and joint planning for the future.

Through the above discussion, it is evident that *cooperation* can be included in the highest level concept of *collaboration* and the extent of trust and commitment plays a pivotal role in discriminating the three concepts. In this sense, this study differentiates *cooperation* and *collaboration* according to the existence of *trust* and *sustainability*. *Sustainability* is postulated to include *commitment* and *long-term orientation*. The differentiation of coordination from cooperation and collaboration is not made because coordination can be considered to imply cooperation (Morgan and Hunt, 1994).

In this study, *cooperation* is defined as a transparent business partnership process where partners work together treating each partner justly and equally on the basis of mutuality for common goals and benefits. *Collaboration* refers to a business partnership process where partners aim to sustain long-term cooperative relationship based on trust between them.

Diverse and numerous concepts representing collaboration by authors raised the necessity to organise the constructs. As such, each sub-construct in this study was derived from the integration of several concepts which are judged to have a similar meaning or to explain the same construct. For example, information sharing, communication, and formalisation were considered to merge into *transparency*. In accordance with the same procedure, sub-constructs of *collaboration* were identified to involve *transparency*, *fairness*, *mutuality*, *trust* and *sustainability*. *Cooperation* is postulated to be a subset of *collaboration* comprised of *transparency*, *fairness*, and *mutuality* among the five factors. Given that the "magnitude (strength) of a relationship" between a customer/buyer and service provider/seller can be measured by trust and commitment (Bove and Johnson, 2001), *collaboration* can also be considered to consist of *cooperation* and “relationship magnitude (strength)”. Additionally, operational definitions of sub-constructs of *cooperation* and *collaboration* were made in SCM and maritime logistics contexts.

3.2 Components of cooperation and collaboration and their operational definitions

3.2.1 Transparency

Transparency implies the extent to which a partner has an open and transparent relationship with the other partner such as smooth communication, information sharing, and clear setting-up of the relationship through prior agreement. Hence, *transparency* involves the concepts of information sharing, communication, and formalisation.

3.2.1.1 Information sharing

Cao *et al.* (2009, p.6617) define information sharing as “the extent to which a firm shares a variety of relevant, accurate, complete and confidential ideas, plans, and procedures with its SC partners in a timely manner.” One important component of cooperation in SCM is information sharing (Cheng and Wu, 2005). The sharing of information among partners is a primary form of collaboration and the exchange of private data among partners is required to establish an efficient SC (Kumar and Nath Banerjee, 2014). Collaboration is important in terms of the broad exchange of information on planning, forecast, and inventory

(Li, 2012). Incomplete information which decision makers have can lead to a lack of coordination (Sahin and Robinson, 2002). A lack of willingness to share appropriate information can make it difficult to establish relationships among SC members based on shared risks and rewards (Richey *et al.*, 2010). Realistic, up to date, and detailed information exchange can lead to better decision-making and SC efficiency and can provide SC visibility (Min *et al.*, 2005). Nonetheless, it is still not easy to decide on which information should be shared with partners in terms of their own privacy (Ramanathan and Gunasekaran, 2014). Additionally, Prajogo and Olhager (2012) suggest that even if information technology between partners is well connected, the connection does not lead automatically and significantly to well-established information sharing between partners and therefore the partners try continuously to build various ways to smooth information sharing as well as information technology connections between them.

3.2.1.2 Communication

The purpose of communication is to find opportunities and areas for improvement (Min *et al.*, 2005). Collaborative communication is defined as "the contact and message transmission process among SC partners in terms of frequency, direction, mode, and influence strategy" (Cao *et al.*, 2009, p.6620). According to them, frequency refers to how often partners contact and direction signifies in which way the communication between partners moves. Mode, namely which methods are used to transmit information, can be divided into "formal (through structured rules and fixed procedures) and informal (through a spontaneous and non-regularised) mode." Influence denotes the content of communication and direct influence. Direct influence implies using recommendations, promises, and appeals to legal obligation. Indirect influence refers to not using explicit commands or veiled threats to change a partner's behaviour.

Collaborative communication has the characteristics of higher frequency, more bidirectional flows, better information mode, and enhanced indirect influence (Mohr and Nevin, 1990).

3.2.1.3 Formalisation

Formalisation is "the extent to which decision making is regulated by explicit rules and procedures" (Dwyer and Oh, 1987, p.349). High formalisation implies formal rules and standardised polices affect decisions and working relationship for an extended period time between SC members. Formalisation can make expectation of what should be done and standard practices established through eliminating ambiguity and clarifying priorities between SC members (Daugherty *et al.*, 2006). Min *et al.* (2005) suggest the following formalisation fields: co-development of performance metrics like performance index, score card, and consequent incentive; advance agreements on collaboration goals or objectives; determination of tasks/responsibilities of partners and reporting process; arrangement of collaborative implementation plans; description of information to be shared; adjustment in collaboration schedules.

Formalisation is a critical element to improve collaborative relationships (Daugherty *et al.*, 2006). Thus, well-established formalisation can enhance the *transparency* between parties.

3.2.2 Fairness

Fairness signifies the extent to which a partner treats the other partner company fairly and justly such as no discrimination between the other partner companies, observation of related regulations and laws, and guarantee of reasonable and just profits for the other partner company. The other terminologies of fairness are justice (Konovsky, 2000) and reciprocity (Bensaou, 1997). The level of cooperation could be affected by the reciprocity (fairness) between partners (Kim et al., 2010). The roots of fairness are found in philosophy, political science and religion (Konovsky, 2000). Only recently SC researchers have become interested in the concept of fairness in a buyer-supplier relationship. Fairness can be conceptualised within collaborative and long-term buyer-supplier relationships in a SC (Hornibrook et al., 2009). A vulnerable party in a SC is sensitive to infringement of fairness by its more powerful partners (Kumar et al., 1995a).

Fairness includes procedural justice and distributive justice (incentive alignment) (Kumar *et al.*, 1995a; Duffy *et al.*, 2003; Griffith *et al.*, 2006). "Distributive fairness is based on reseller outcomes, whereas procedural fairness concerns supplier behaviour" (Kumar *et al.*, 1995a, p.55). Although a debate exists, procedural justice plays more important role than distributive justice in fostering long term collaborative relationships (Tyler and Lind, 1992; Kumar *et al.*, 1995a). Fairness is also a very important issue in the SCs in other fields such as the food industry: power abuse and unfairness were detected between UK supermarkets (food retailers) and their suppliers (Duffy *et al.*, 2003) and coffee bean suppliers and prominent retailers (Maloni and Brown, 2006).

3.2.2.1 Procedural justice

Equity theory which focuses on fair distribution is the basis of evolution of procedural justice (Korsgaard *et al.*, 1995). “Procedural justice refers to when a firm perceives the development and administration of relationship policies to be fair and equitable” (Griffith *et al.*, 2006, p.91). That is, procedural justice implies how fairly a firm and its personnel deal with its partner firm. Procedural justice concentrates on the fairness of procedures itself by which decisions are made and on the attitudes of people affected by those decisions (Korsgaard *et al.*, 1995).

3.2.2.2 Distributive justice

“Distributive justice refers to how equitable the firm perceives the distribution of relationship resources relative to inputs” (Griffith *et al.*, 2006, p.91). Distributive justice is sometimes interchanged with incentive-alignment. “Incentive-alignment refers to the degree to which chain members share costs, risks, and benefits” (Simatupang and Sridharan, 2005, p.46). Successful partnerships depend on whether participants share gains and losses equitably and fairly or not (Cao *et al.*, 2009). The sharing of benefit is one of the key elements of SCCs (Toktay *et al.*, 2000). Mutually sharing risks and rewards are required for effective SCM (Ellram and Cooper, 1990). If the compensation for its contribution to the SC of a company is not more than that which could be obtained before cooperation, the firm would not cooperate (Nassirnia and Robinson, 2013). No guarantee of redistribution of benefit does not give any incentive for contributing to the SC of its members (Hosoda and Disney, 2006). Appropriate and acceptable outcome distribution can make the exchange partners view their relationship as beneficial and reciprocate through additional inputs (Griffith *et al.*, 2006). Distributive justice, the incentive alignment, ensures satisfactory levels of cooperation (Harland *et al.*, 2004).

3.2.3 Mutuality

Based on interdependence and RDT, *mutuality* refers to exchange relationships between organisations (Thomson *et al.*, 2009). In this study, *mutuality* implies the extent to which a partner treats the other partner as an equal business partner and is willing to support the other partner on the basis of mutual understanding. Such notions as goal congruence, resource sharing, joint problem solving, joint performance measurement, joint knowledge creation can be included in the *mutuality*.

3.2.3.1 Goal congruence

Inter-organisational cooperation arises when parties perceive mutual performance objectives (Schermerhorn, 1975). Goal congruence implies "the extent to which SC partners perceive their own objectives are satisfied by accomplishing the SC objectives" and "congruence signifies that SCC requires a degree of mutual understanding and agreement across firm attributes, values, beliefs, and practices" (Cao *et al.*, 2009, p.6618). In addition, decision synchronisation refers to "the degree to which the SC members become involved in joint decision making at planning and operational levels". (Simatupang and Sridharan, 2005, p.50)

3.2.3.2 Resource sharing

Resource sharing refers to “the process of leveraging capabilities and assets and investing in capabilities and assets with SC partners.” (Cao *et al.*, 2009, p.6620). According to them, sustainable collaborations have to be maintained by considerable mutual resource investments and therefore, non-financial investments such as time, money, training, and technology as well as financial investments are essential. Sufficient commitment of management time prospers in collaborative relationships (Min *et al.*, 2005). Meanwhile, it is still difficult to determine how much investments could create such collaborations (Ramanathan and Gunasekaran, 2014).

3.2.3.3 Joint problem solving

Problem solving implies settling matters like disagreements and conflicts between partners (Lusch and Brown, 1996), and unexpected disasters (Kumar and Nath Banerjee, 2014). Mutually advanced process improvement can be caused through joint problem solving procedures. Building cross-functional, cross-original teams and co-locating each other’s personnel to solve issues may progress into a virtual integration of the SC process (Min *et al.*, 2005).

3.2.3.4 Joint performance measurement

Measuring performance of collaboration is required to encourage suitable behaviours and make effective collaboration possible (Slone, 2004). Monitoring and measuring performance properly can assure the success of collaborative efforts. Partners should develop common measures to determine rewards for successful collaboration efforts and to confirm whether a performance gap should be tackled (Min *et al.*, 2005).

3.2.3.5 Joint knowledge creation

Joint knowledge creation can be defined as the extent to which SC partners better understand and react to a market and an environment by collaboration (Malhotra *et al.*, 2005). Knowledge creation activities have two types: one is the knowledge exploration which refers to searching and gaining new and relevant knowledge, and the other is the knowledge exploitation which signifies assimilating and applying knowledge (Cao *et al.*, 2009). The new knowledge creation has been one of the main purposes of collaboration (Hardy *et al.*, 2003).

3.2.4 Trust

In this study, *trust* refers to the extent to which a partner company can be trusted in terms of trustworthiness, good faith and fulfilment of obligations. Trust is defined as the extent to which partners consider each other as believable (Ganesan, 1994). Trust implies “the firm’s belief that another company will perform actions that will result in positive outcomes for the firm, as well as not take unexpected actions that would result in negative outcomes for the firm” (Anderson and Narus, 1986, p.326). Therefore, trust can be considered as a belief or an expectation of a partner that the other partner will not take advantage of its vulnerability caused by the acceptance of risk inevitably inherited in their relationship or transaction (Lane, 2000). According to Nyaga and Whipple (2011), companies which trust each other are apt to regard the relationship as more favourable.

Credibility and honesty are two components of trust (Eyuboglu et al., 2003) whereas Wang et al. (2008) measure trust through two dimensions which are credibility and benevolence. Credibility is a firm's belief about the sincerity (Dwyer and Oh, 1987) and the fulfilment of promise and obligation of its partner (Anderson and Narus, 1990). Credibility can conceptually be divided into dependability and competence. Dependability is defined as "the belief that an organisation will do what it says it will do; that it acts consistently and dependably" and competence implies "the belief that an organisation has the ability to do what it says it will do" (Paine, 2003, p.5).

Trust can result in decreasing a variety of costs related to *ex ante* negotiation, conclusion of a contract as well as *ex post* transactions (Ryu et al., 2007). Trust can contribute to decreasing anxiety and uncertainty between partners (Wang et al., 2008) and reducing transaction costs among them (Ganesan, 1994; Kwon and Suh, 2004). A perceived threat of information asymmetry and performance ambiguity can be reduced by trust (Batt, 2003). Trust can play a role of restraint of the other partner's opportunistic behaviour (Bradach and Eccles, 1989; Ganesan, 1994) and make a dominant partner refrain from exerting its power over the weaker partner (Ganesa, 1994; Mei and Dinwoodie, 2005). Trust in SCs can be fostered by sharing similar goals between SC members and the willingness to make relationship-specific investments of the members (Batt, 2003).Trust also makes partners believe that long run idiosyncratic investments can be feasible with minimal risks (Ganesan, 1994). Trust of a more powerful partner towards the other weaker partner lessens the possibility for the dominant partner to use alternative sources of supply and increases the tolerance of the powerful partner about any short-term inequities which can arise in their relationship (Kumar, 1996).

However, establishing trust is difficult and trust must be gained in that trust can be formed only after the other party proves its abilities to solve problems, and its loyalty (Min et al., 2005). The extent of trust towards each partner can vary according to relative power between SC members. “Shippers trust the carriers with which they work but are not as committed to them because there are so many available and thus switching is easy” (Golicic, 2007, p.731).

3.2.5 Sustainability

In this study, *sustainability* can be defined as the extent to which a partner sustains and strengthens continuously its cooperative relationship with the other partner. *Sustainability* contains the concepts of commitment and long term orientation. In this vein, *sustainability* is a similar concept as Gardner *et al.*’s (1994) “relationship extendedness” indicating loyalty and long-term expectations. A high level of trust and commitment among SC practitioners is the foundation of creation of successful SC performance (Kwon and Suh, 2004).

3.2.5.1 Commitment

Commitment refers to “an implicit or explicit pledge of relational continuity between exchange partners” (Dwyer *et al.*, 1987, p.19). Commitment is also defined as “the extent to which one party believes the relationship is worth spending energy to maintain and promote” (Paine, 2003, p.5). In the context of commitment, “the parties are tolerant of each other’s deficiencies (within reason) and that each will cooperate and not act opportunistically” (Min *et al.*, 2005, p.243). “Conceptually, organisational commitment within SCs can be compared to the willingness of the weaker party to commit to the relationship in the long term” (Hornibrook *et al.*, 2009, p.8). The level of commitment in a relationship is regarded as a key element of relationship quality (Nyaga and Whipple, 2011). “A committed partner wants the relationship to endure indefinitely and is willing to work at maintaining it” (Morgan and Hunt, 1994, p.23).

3.2.5.2 Long-term orientation

Long term orientation implies the desire of a partner towards having a long term relationship with a particular partner (Ganesan, 1994). Construction, maintenance and enhancement of long-term relationships with SC partners in SCM is required for effective SCM (Cooper *et al.*, 1997). The options and results of the current period are only concerns for parties with a short-term orientation whereas parties with a long-term orientation are interested in current and future outcomes as well as accomplishing future goals (Ganesan, 1994). As partners start to trust each other because of the success of their collaborative arrangements, collaborative relationship and mutual cooperation are likely to be enhanced. “The partners became more willing to share potential gains and potential risks because of the long-term opportunities associated with the relationship” (Min *et al.*, 2005, p.250). Long term relationship between partners can promote diverse forms of collaborative behaviours between them. Through the long term relationships with carefully selected customers, supplier companies can obtain the same level of growth as or higher level of profitability than firms utilising transactional approach to serving their customers (Kalwani and Narayandas, 1995).

3.2.6 The summary of concepts construction

To recap, Figure 3-1 and Table 3-1 represent the composition of and the grounds for *cooperation* and *collaboration* of this research. Given that the “relationship magnitude (strength)” between a customer/buyer and service personnel/provider/seller can be indicated by trust and commitment (Bove and Johnson, 2001), this study postulates that *collaboration* is comprised of components representing *cooperation* and another components representative of “relationship magnitude (strength)” such as *trust* and *sustainability*.

Figure 3-1 Construction of cooperation and collaboration

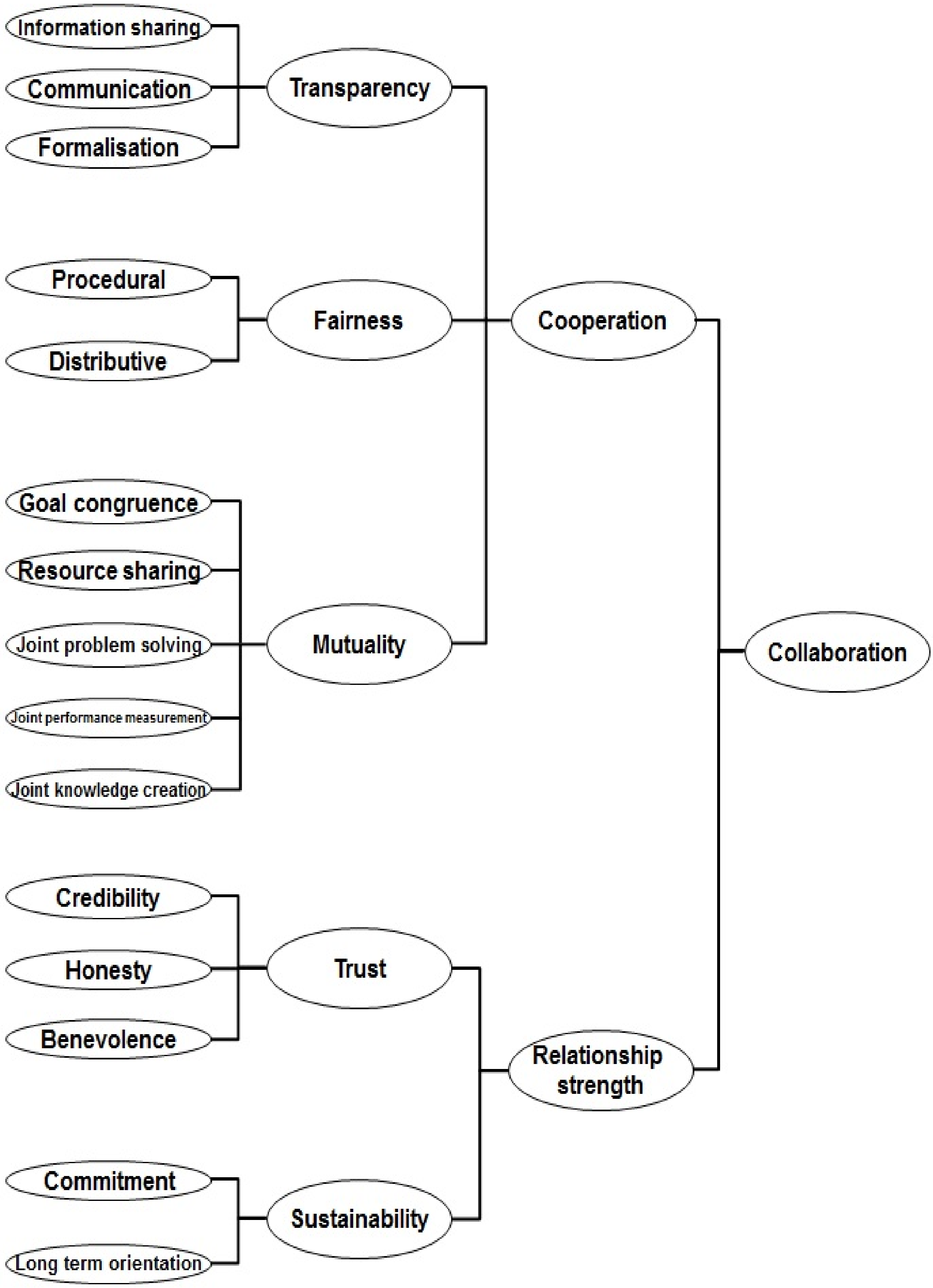


Table 3-1 Grounds for construction of cooperation and collaboration

Components of cooperation and collaboration		**Theory/Author**
Transparency	Information sharing	RT, Sahin and Robinson (2002), Min *et al.* (2005), Cheng and Wu (2005), Simatupang and Sridharan (2005), Ryu *et al.* (2007), Cao *et al.* (2009), Chen *et al.* (2011), Cao and Zhang (2011), Prajogo and Olhager (2012), Li (2012), Kumar and Nath Banerjee (2014), Ramanathan and Gunasekaran (2014)
	Communication	RT, Mohr and Nevin (1990), Min *et al.* (2005), Cao *et al.* (2009), Cao and Zhang (2011), Kumar and Nath Banerjee (2014)
	Formalisation	Dwyer and Oh (1987), Min *et al.* (2005), Daugherty *et al.* (2006)
Fairness	Procedural justice and distributive justice	SET, Ellram and Cooper (1990), Tyler and Lind (1992), Korsgaard *et al.* (1995), Kumar *et al.* (1995a), Kumar *et al.* (1995b), Bensaou (1997), Konovsky (2000), Toktay *et al.* (2000), Duffy *et al.* (2003), Harland *et al.* (2004), Simatupang and Sridharan (2005), Griffith *et al.* (2006), Maloni and Brown (2006), Hosoda and Disney (2006), Hornibrook *et al.* (2009), Cao *et al.* (2009), Kim *et al.* (2010), Nassirnia and Robinson (2013), Kumar and Nath Banerjee (2014)
Mutuality	Goal congruence	SCT, Simatupang and Sridharan (2005), Cao *et al.* (2009), Kim *et al.* (2010), Cao and Zhang (2011)
	Resource sharing	RBT, RT, Min *et al.* (2005), Cao *et al.* (2009), Cao and Zhang (2011), Kumar and Nath Banerjee (2014), Ramanathan and Gunasekaran (2014)
	Joint problem solving	Lusch and Brown (1996), Min *et al.* (2005), Kumar and Nath Banerjee (2014)
	Joint performance measurement	Slone (2004), Min *et al.* (2005), Kumar and Nath Banerjee (2014)
	Joint knowledge creation	Malhotra *et al.* (2005), Cao *et al.* (2009), Cao and Zhang (2011)
Trust		SET, SCT, Anderson and Narus (1986), Dwyer *et al.* (1987), Dwyer and Oh (1987), Bradach and Eccles (1989), Anderson and Narus (1990), Ganesan (1994), Kumar *et al.* (1995b), Paine (2003), Eyuboglu *et al.* (2003), Kwon and Suh (2004), Min *et al.* (2005), Ryu *et al.* (2007), Wang *et al.* (2008), Kim *et al.* (2010), Delai and Takahashi (2011), Nyaga and Whipple (2011), Chen *et al.* (2011), Kumar and Nath Banerjee (2014),
Sustainability		TCT, SET, Dwyer *et al.* (1987), Ganesan (1994), Morgan and Hunt (1994), Kalwani and Narayandas (1995), Cooper *et al.* (1997), Paine (2003), Min *et al.* (2005), Ryu *et al.* (2007), Wang *et al.* (2008), Hornibrook *et al.* (2009), Chen *et al.* (2011), Delai and Takahashi (2011), Nyaga and Whipple (2011), Prajogo and Olhager (2012), Ramanathan and Gunasekaran (2014)

With regard to research gap, to date the literature relating to cooperation and collaboration has principally adopted a focus involving an operational process perspective. Whilst this focus has generated useful indicative findings, the lack of additional empirical evidence in SCM has resulted in extensive anecdotal material. A major research gap relates to an urgent requirement for a more comprehensive empirical study of cooperation and collaboration in SCM. This gap exposes a second research gap relating to a requirement to crystallise key concepts further, in order to devise a more appropriate research instrument. Finally, the dearth of empirical measurement studies in terms of an index is apparent from only two prior relevant research studies in SCM as shown in 2.3.4., and within the published literature, none involving shippers and shipping companies. Bearing in mind these research gaps, it is proposed that the most urgent requirement after clarifying relevant nomenclature is to devise a more comprehensive instrument to measure the extent of cooperation and collaboration between shippers and shipping companies, which may also be indicative of broader inter-firm relationships in SCs.

3.3 Hypotheses development

It cannot be denied that *cooperation* can affect both trust and sustainability such as commitment and long-term orientation. “Relationship strength” such as mutual trust and shared commitment involves antecedents such as no opportunistic behaviour and cooperation (Hausman, 2001). The examples of antecedents of trust and commitment can be information, friendship behaviours, satisfaction, and cooperation (Bove and Johnson, 2001). On the other hand, according to Van de Ven and Walker (1984) and Levinthal and Fichman (1988), trust and commitment between parties play a role of precursors to cooperation. Albeit, this study postulates that cooperation has a direct effect on only trust mainly based on Anderson and Narus's (1990) argument. The cooperation between a manufacturer and a distributor plays an antecedent role of trust, not a consequence of trust (Anderson and Narus, 1990). Therefore, the following hypothesis can be established:

H_1. There is a positive relationship between cooperation and trust.

In addition, given that the process of building trust needs continuous and repeated cooperative endeavours or experiences between partners (Min *et al.*, 2005) and that "trust is an important concept in understanding expectations for cooperation" (Dwyer *et al.*, 1987), the establishment of the following hypotheses between components of *cooperation* and *trust* is also reasonable:

H_2. There is a positive relationship between transparency and trust.

H_3. There is a positive relationship between fairness and trust.

H_4. There is a positive relationship between mutuality and trust.

With regard to *transparency*, information sharing plays an essential role in the trust-building process among SC practitioners (Kwon and Suh, 2005; Ghosh and Fedorowicz, 2008). In addition, higher levels of information sharing and communication lead to trust (Zaheer and Venkatraman, 1995; Kwon and Suh, 2005).

In terms of *fairness*, "trust and commitment can be developed, even in highly asymmetrical relationships if the vulnerable party is treated fairly by its more powerful partner" (Kumar *et al.*, 1995a, p.62). Fairness can enhance a long term orientation from one' partner (Griffith *et al.*, 2006). Commitment and trust are positively related to and are affected by distributive justice (Folger and Konovsky, 1989; Korsgaard *et al.*, 1995). Procedural justice leads to positive results such as long-term commitment (Hornibrook *et al.*, 2009). To put it another way, many authors argue that fairness can lead to both trust and sustainability. However, following Dwyer *et al.*'s (1987) argument that development of trust between partners requires justice in interactions, this research posits that only trust is directly affected by fairness. Sustainability can be affected indirectly by fairness through the mediating role of trust.

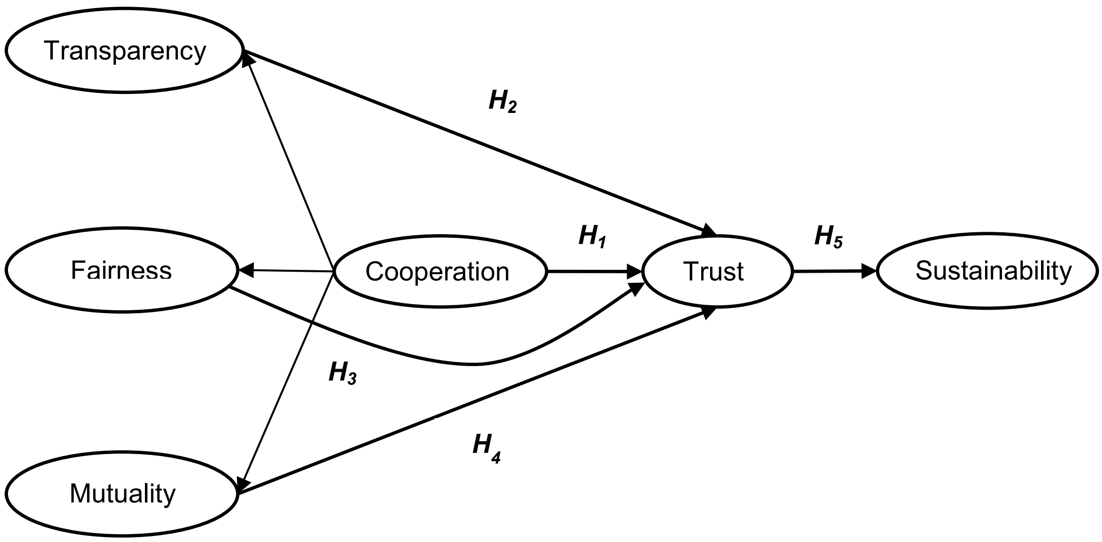
Mutuality, exchange relationships between partners (Thomson *et al.*, 2009), has something in common with components of cooperation or collaboration which other authors employ. For example, Simatupang and Sridharan (2004) point out decision synchronisation as one collaborative enabler. Min *et al.* (2005) give joint planning, joint problem solving, joint performance measurement, leveraging resources and skills as examples of collaboration. Cao *et al.* (2009) argue that collaboration is comprised of elements such as goal congruence, decision synchronisation, resource sharing, joint knowledge creation. All these components can be included in the *mutuality* of this study. Reinforcement and expansion of the relationship such as trust as well as efficiency and effectiveness can be the results of the collaboration (Min *et al.*, 2005) i.e. *mutuality* of this research.

Concerning the relationship between *trust* and *sustainability*, a positive relationship between trust and commitment is identified (Bove and Johnson, 2001; Kwon and Suh, 2004; Golicic, 2007). A partner firm's commitment to a relationship can be increased by incremented levels of trust between the partners (Morgan and Hunt, 1994). That is to say, commitment is determined by trust (Achrol, 1991; Morgan and Hunt, 1994). Trust between parties has been repeatedly supported as a primary element of establishing long-term orientation (Ryu *et al.*, 2007). The long term partnership shows that the mutual trust between partners has been advanced (Prajogo and Olhager, 2012). Hence, trust has a positive effect on the long-term orientation (Ryu *et al.*, 2007). The probability of a long term orientation towards one partner can be incremented by the other partner's trust in the one partner through reduced risk of opportunistic behaviours and lowered transaction costs (Ganesan, 1994). Therefore, this study formulates the following hypothesis:

H_5. There is a positive relationship between trust and sustainability.

Figure 3-2 below shows the relationships among components of *collaboration* and corresponding hypotheses. Propositions are suggested that the components of *cooperation* such as *transparency*, *fairness*, and *mutuality* influence *sustainability* by way of the mediating variable, *trust*. How antecedents of *trust* such as *transparency*, *fairness* and *mutuality* affect trust, which subsequently has an effect on *sustainability*, is examined.

Figure 3-2 Conceptual framework of this study



3.4 Further hypotheses development

This research aims to reveal the extent of cooperative and collaborative relationships between shippers and shipping companies as a case study of collaboration in SCs. As described in 1.6.2, the coastal shipping industry consists of smaller businesses than the seagoing industry (MOF, 2016b). Besides, coastal shipping is responsible for logistics between domestic ports whereas ocean-going shipping mainly accomplishes the delivery of commodities between domestic and foreign ports or between foreign ports. Accordingly, it can be posited that owing to different business scope and size, each type of shipping registered may have different kinds of shippers and subsequently the extent of cooperation and collaboration of different shippers would differ. For this reason, the following hypothesis can be suggested:

H_6. The extent to which shippers of the ocean-going and the coastal shipping industry cooperate and collaborate with their shipping companies will differ.

As discussed in Chapter Two, various types of vessels have been introduced in line with the needs of shippers possessing different kinds of cargoes (Branch, 2007). Different types of cargoes affect the selection of vessel types of shippers. Shippers contract shipping companies possessing different kinds of vessels according to their necessities. Therefore, it is reasonable to consider that different types of vessels have their own shippers and different shippers have different characteristics towards shipping companies in terms of cooperation and collaboration. Given the above proposition, the following hypothesis can be formulated:

H_7. The extent to which shippers of different types of vessels cooperate and collaborate with their shipping companies will differ.

Similarly, different contract periods with shippers can occur along with types of vessels. To put it simply, contract periods can be related to types of vessels. For example, in liner shipping, direct shippers' purchase of freight services from container shipping companies usually is based on one-year contracts (Frémont, 2009; Fransoo and Lee, 2013). However, the contracts between freight forwarders/NVOCCs and shipping companies show a relatively shorter period from one to three months (Fransoo and Lee, 2013). In liner shipping, a long period of contract gives the stability of the origins and destinations of containers and the possibility of providing large scale assembly and distribution services by shipping lines. Furthermore, their container stock can be effectively controlled

(Frémont, 2009). In the case of tramp shipping, agricultural product markets are the fields where traders are particularly active and usually utilise spot transport markets. However, long-term contracts between shippers and shipping companies are found in the trade of iron ore, forest products and motor cars. Similarly, oil and LPG tanker transport is usually based on the long-term contract (Stopford, 2009). Hence, the following hypotheses can also be provided:

> *H_8. Different contract periods will show different levels of cooperation and collaboration between shippers and shipping companies.*
>
> *H_9. Different types of vessels along with different contract periods will show different levels of cooperation and collaboration between shippers and shipping companies.*

These four additional hypotheses are tested through the comparison of the differences of CCSIs across shipping registered, different kinds of vessels and contract periods in Chapter Seven.

3.5 Summary

This chapter suggested the conceptual framework of this research and established corresponding hypotheses. The conceptualisation and operationalisation of cooperation and collaboration was made. The components of the two concepts were also proposed and operationalised. The hypotheses include four concerning the differences of CCSIs according to shipping registered, vessel types, and contract periods as well as five regarding structural relationships among sub-constructs of cooperation and collaboration.

The next chapter addresses the methodology of this research. The philosophical and methodological perspective of this research is introduced. How to collect data targeting shipping companies is suggested. General description concerning statistical analysis techniques such as FA, SEM and MANOVA which can support empirically the conceptual model is provided.

Chapter 4 Research methodology

A variety of different opinions of research methodology exist (Wilson, 2014). Generally, methodology implies how to think about and to study social reality (Strauss and Corbin, 1990). To put it another way, “methodology is concerned with the overall approach to the research process. This includes everything from theoretical application to the collection and analysis of data” (Wilson, 2014, p.3). On the other hand, methods mean “techniques and procedures used to obtain and analyse data” (Saunders *et al.*, 2016, p.4). Quantitative and qualitative analysis techniques as well as questionnaires, observation and interviews are included in the methods (Saunders *et al.*, 2016). In other words, methods are related to how to collect and analyse data (Wilson, 2014).

Although research methodology has different meaning according to authors, it could be said that research methodology has the following six main components: research philosophy, research approach, research strategy, research design, data collection and data analysis (Wilson, 2014).

This chapter consists of four sections. Research philosophy and methodology of this study are addressed in Section One. The design of this study is followed in Section Two. Subsequently, Section Three deals with how to analyse data. Several statistical techniques such as EFA, CFA1, SEM and MANOVA are included in Section Three. The last section summarises this chapter.

4.1 The philosophical and methodological perspective of this research

This research follows the ontological perspective of subjectivism: social actors create social phenomena and social phenomena cannot be understood apart from social actors (Saunders et al., 2016). This is because this research aims to reveal how SC members (shipping companies) think of and evaluate the other SC members' (shippers') willingness to cooperate and collaborate with them through CCSIs. To put it another way, this research is based on the assumption that the SC members (social actors) could create and develop a culture of cooperation and collaboration (social phenomenon). This is because the cooperative and collaborative spirit of the other members (shippers) can be reflected and identified in the interactions between the SC members. Further, SC members (shipping companies) can provide their own interpretations or opinions towards the other members' (shippers') attitudes.

The tradition of post-positivism epistemologically and axiologically (value-free) is also followed. This is because this research attempts to estimate, not exactly know, the extent to which the cooperative and collaborative spirit is through the CCSIs. This study agrees with the argument of post-positivism: reality cannot be fully understood and only be estimated (Wilson, 2014) and the understanding of human behaviours cannot be obtained through positivism (Creswell, 2013). Specifically, this study adheres to the position of post-positivism when the state of cooperation and collaboration is explored, namely in the course of calculation of the CCSIs and when some hypotheses are tested. The hypotheses were already obtained and developed from existing theories and literature. The hypotheses represent the causal relationships among constructs consisting of the cooperation and collaboration.

However, this study also adopts the epistemological and axiological (value-laden) stance of interpretivism when the implications and conclusions of this study are explored. In other words, this study explores and suggests how to enhance SC cooperation and collaboration between shippers and shipping companies in respect of the empathy with the shipping companies' stance. To sum up, it could be possible that the philosophical perspective of this study can be named as pragmatism in that this research adopts subjectivism in ontology and post-positivism and interpretivism in epistemology simultaneously to achieve properly the objectives of this research.

To measure the extent to which a SC member is cooperative and collaborative towards the other SC member (at the stage of development of the index) and to test scientifically relationships among the sub-constructs composing the cooperative and collaborative spirit, this study is in line with the methodological stance of positivism or post-positivism. Scientific methodology (research strategy) such as a survey including a questionnaire and an interview is utilised. Following the methodological position of interpretivism, this research also partly considers an inductive approach when drawing implications and conclusions. To summarise, the methodological perspective of this study could be described as pragmatism in that the methodologies of positivism or post-positivism and interpretivism and mixed methods (qualitative and quantitative) are simultaneously considered in this one research.

Paradigm and philosophy of this research can be summarised in Table 4-1 below.

Table 4-1 Paradigm and philosophy of this research

	Positivism (Naïve Realism)	Post-positivism (Critical Realism)	Interpretivism Constructivism (Relative Realism)	Pragmatism
Ontology			(subjectivism) ✓	✓
Epistemology		✓	✓	✓
Axiology		✓	✓	✓
Methodology	✓	✓	✓	✓

Source: Adapted from Saunders et al. (2016), Howell (2013), Wahyuni (2012) and Wilson (2014)

4.2 Design of this research

A research design is a framework or plan about how to collect and analyse data. Data are divided into primary data which are collected for the author's own study and secondary data which have been already issued (Wilson, 2014). This study mainly uses the primary data to analyse the constructs showing cooperative and collaborative spirit and various secondary data are also used. Primary data collection instruments consist of three types: interviews - personal (face-to-face), telephone, focus group; questionnaires - postal, email, fax; and observation - participant, non-participant (Wilson, 2014).

As an instrument of data collection and measurement, a questionnaire is utilised in this study. The questionnaire is comprised of Likert-scale questions, closed questions and a few open questions. The Likert-scale was invented to detect a respondent's attitude or opinion by the American psychologist Rensis Likert (Wilson, 2014). Even if many different types of measures exist, the vast majority of survey questionnaires use Likert scales (Schmitt *et al.*, 1991). This study mainly acquires or explores the opinions of shipping companies in South Korea regarding the attitudes or thoughts of shippers in the same country as a case of research concerning collaboration in SCs. That is why the Likert-scale is chosen. Each item is measured through seven-point Likert scales. The questionnaire is distributed via email to the business department of shipping companies (SC members) registered in South Korea which have freight vessels, targeting general managers who have a lot of contact with shippers (the other SC members). The collection of questionnaires is also conducted by email. To heighten the response rate, several waves of emails and phone calls are employed. A reminder is essential to enhance response rate (Wilson, 2014).

A population means “a clearly defined group of research subjects” which should be defined in accordance with the types of case found in it (Wilson, 2014). The main object of survey (population) is confined to the shipping companies registered in South Korea. As described already in Chapter One, the population of this research consists of 183 ocean-going and 723 coastal shipping companies as of late May 2016 (MOF, 2016a). Among the population, the sample consisting of 183 sea-going and 420 coastal shipping companies is chosen. Private companies of 303 in coastal shipping industry are not included in this survey because of some practical problems. Details are discussed in 6.1.

To enhance content validity of this research, only the items closely related to the shipping industry are selected through semi-structured interview with industrial experts. To improve reliability and content validity for each dimension and indicator and to develop final reliable questionnaire, Q-sort technique and pilot testing are also executed with experts including professors, senior researchers, senior-level practitioners and public officers. Reliability concerns the extent to which stable and consistent results could be resulted by repeated measurements under constant condition while validity is concerned with the relationship between a construct and indicators (Wilson, 2014). Semi-structured interviews are repeatedly utilised in the pilot test stage. Pilot study implies "a small-scale study that is carried out prior to the main survey to try to increase levels of reliability and validity" (Wilson, 2014, p.168). The pre-assessment includes checking the definition and the wording of the constructs and items through email.

After data collection, the data are mainly analysed quantitatively using computer programs such as SPSS 23 and AMOS 22. Non-response and common method biases are tested. To verify and determine common factors of items, EFA is used. Final items for statistical tests are confirmed by CFA1. CFA1 identifies the model fit and convergent and discriminant validities of constructs. Through path analysis, the hypotheses and the causal relationships among the sub-constructs which were deductively developed in Chapter Three are tested. The CCSIs in the ocean-going shipping and coastal shipping industries of South Korea are developed through figured items and the weights of items and constructs via EFA. Another statistical technique, MANOVA is employed to test the differences of two dependent variables [both Cooperative Spirit Index (CSI1) and Collaborative Spirit Index (CSI2)] in terms of types of shipping registered, vessel types, and period of contract with shippers. Statistical methods which this research adopts are detailed in the next section.

4.3 How to analyse data: Statistical techniques

4.3.1 Outline of factor analysis

Factors imply the groups of variables which are very closely interrelated (Byrne, 2010). The factors are presumed to indicate dimensions within the data (Byrne, 2010; Hair *et al.*, 2014). FA provides understanding the structure of a set of variables and helps reducing a data set to a more manageable level (Field, 2009). The fundamental dimensions or constructs which are assumed to underlie the original variables can be identified by the factor analytic technique with a minimum loss of information on the original variables. In other words, FA is the most efficient method to identify whether the dimensions which were conceptually defined in a model can be suggested by the derived factors (Hair *et al.*, 2014). Because FA is solely interested in the relations between factors and their indicators, any direct regression structure among factors is not considered in the method (Byrne, 2010).

FA can be divided into R- and Q-type FA. The unit of analysis of R-type FA is a variable whereas that of Q-type FA is a respondent. The R-type FA is the most common and Q-type FA is seldom used because of its computational difficulties (Hair *et al.*, 2014).

The factor analytic techniques can also be divided into EFA and CFA1. EFA explores the data and suggests how many factors are needed to best describe the data. EFA makes all measured variables associated with all factors. EFA reveals which each item loads highly on only one factor and less on other factors (Hair *et al.*, 2014). In EFA, without knowing *a priori* how many factors exist, factors emerge from only statistical results, not from a theory (Byrne, 2010; Hair *et al.*, 2014). However, CFA1 has a different philosophical stance (Hair *et al.*, 2014). Based on a theory, CFA1 beforehand specifies the number of factors and which each measured variable loads on one factor (Byrne, 2010; Hair *et al.*, 2014). In contrast, EFA assigns each variable to factors according to the statistical technique (Byrne, 2010; Hair *et al.*, 2014).

In CFA1, cross loadings are not specified because a variable is assigned to only a single factor. To put it simply, EFA decides the number of factors and loadings based on and after statistical outcomes whereas CFA1 identifies how well theoretically and beforehand assigned factors fit reality. CFA1 provides confirmatory test results of a measurement theory which specifies how well constructs in a theoretical model are logically represented by measured variables. Therefore, a measurement theory is necessary for conducting CFA1 whereas EFA does not need any theories to derive factors. To summarise, EFA results can help developing theory and proposing a measurement model whereas CFA1 can confirm the measurement model developed with the help of EFA (Hair *et al.*, 2014). The EFA can be executed by various statistical packages such as SPSS while a special structural equation model program is needed to carry out the CFA1 (Easterby-Smith *et al.*, 2015).

FA is different from dependent statistical techniques such as multiple regression, MANOVA, discriminant analysis in that the dependent techniques employ explicitly dependent and independent variables and predict dependent variables whereas FA does not discriminate between dependent and independent variables and just extracts factors explaining the entire variables. FA provides a much smaller set of composite measures such as representative variables, factor scores or summated scales for further and subsequent multivariate analyses (Hair *et al.*, 2014).

A sample for FA should have 50 observations minimum and a sample size with 100 or larger observations is more desirable (Hair *et al.*, 2014). More specifically, the sample size should have at least five to ten times more observations than the number of observed variables (Tinsley and Kass, 1979; Hair *et al.*, 2014).

To achieve the objectives a and b in this research, both EFA and CFA1 are utilised. For the research objective c (the calculation of CCSIs), EFA is again adopted.

4.3.2 Overview of structural equation modelling

SEM is also adopted to accomplish the objectives a and b in this research. SEM is a powerful statistical method that takes a confirmatory approach when analysing a structural theory (Byrne, 2010). SEM integrates a structural model with a measurement model into a simultaneous test (Bagozzi, 1981). SEM gained popularity in a comparatively short period of time and holds the position of a dominant multivariate technique (Hair *et al.*, 2014), especially for non-experimental research (Bentler, 1980).

There are several computer programs such as LInear Structural RELations (LISREL), AMOS, EQS, Mplus, and CALIS for performing SEM. LISREL and AMOS are widely used. However, the choice of a SEM program mainly depends on a researcher's preference and availability. There are also several estimation techniques for SEM such as ordinary least squares regression, Maximum Likelihood Estimation (MLE), WLS. Among the methods, MLE is the default method in most SEM programs and has been utilised widely (Hair *et al.*, 2014).

SEM model has two components such as a measurement model (a CFA1 model) and a structural model (a path analysis). A measurement model shows how underlying constructs are represented by measured variables and a structural model depicts the relationships among the latent constructs (Byrne, 2010; Hair *et al.*, 2014).

A two-step procedure for utilising SEM is suggested by Anderson and Gerbing (1988). The approach has been advocated by the majority of SEM researchers (Garver and Mentzer, 1999). In the first step, a measurement model is tested in terms of construct validity. Once the validity of the model is confirmed, the second step estimates the structural relationship between constructs and tests the theoretical model (Anderson and Gerbing, 1988). In other words, if a CFA1 model shows acceptable results in terms of model fit, construct validity and reliability, then the structural model is tested with the same sample as the CFA1 model (Hair *et al.*, 2014).

A measurement model includes the following four stages: the definition of constructs, the development of the overall measurement model, design of a study to create empirical results and the assessment of the measurement model validity. A structural model contains the following two stages: the specification of the structural model and the assessment of the structural model validity (Hair *et al.*, 2014).

Because this work is attempting to devise a comprehensive measure of cooperation and collaboration in SCM, it is useful to note that SEM is the most appropriate method when several measured variables and corresponding multiple and distinguished constructs exist. SEM is also a useful method for testing theories in which multiple equations represent a series of dependence relationships and for establishing a causal inference. SEM should be based on a theory for the assignment of both a measurement and a structural model because this technique postulates a confirmatory analysis. Any mixture of dependence and correlational relationships between exogenous (independent) and endogenous (dependent) constructs can be depicted in SEM. However, the specification of any relationships should have strong theoretical support (Hair *et al.*, 2014).

4.3.2.1 Measurement model

This research conducts CFA1 to accomplish objectives a and b. The main objective of CFA1 is the evaluation of construct validity of a proposed measurement theory. Construct validity implies how well a set of measured items actually represent the theoretical constructs that those items are intended to measure (Garver and Mentzer, 1999). CFA1 reveals the linkage of constructs to items (factor loading estimates) and the relationships among constructs (construct correlations estimates). With these two estimates, the proposed measurement theory can empirically be examined. Acceptable GOF for a measurement model and evidence of construct validity determine the validity of the measurement model. Construct validity consists of four components: convergent, discriminant, nomological, and content (face) validity (Hair *et al.*, 2014). Unlike content validity, the other three methods for assessment of construct validity can be empirically tested (Garver and Mentzer, 1999; Hair *et al.*, 2014).

4.3.2.2 Structural model

To attain the objective b and to test hypotheses H_1 to H_5, after testing a measurement model with CFA1, the structural or theoretical model is tested. Only when acceptable fit of a measurement model is obtained and the validity and reliability of a measurement model is verified, the specification and the validity evaluation of a structural model can be conducted. The CFA1 factor pattern should be sustained in the specification of a structural model. The structural model focuses on the relationships among constructs. A structural model can be defined as the model representing the theory with a set of structural equations. A structural model represents a structural theory by specifying relationships among constructs (Hair *et al.*, 2014).

A CFA1 model does not distinguish between exogenous and endogenous constructs whereas a structural model introduces the difference. The exogenous constructs are regarded as the traditional independent variables (predictors) and the endogenous constructs the traditional dependent variables (outcomes). The structural theory is tested by examining how the exogenous constructs affect endogenous constructs. One or more of the endogenous constructs can function simultaneously as a predictor and an outcome in a structural model. The specification of structural model implies the assignments of dependence relationships among constructs based on the proposed theoretical model. Specific relationships among constructs in a structural model represent each hypothesis which the theory already postulated (Hair *et al.*, 2014, pp.650-662).

The overall fit of a structural model is assessed by the same criteria as the measurement model. After examining the overall fit, the individual path estimates displaying each hypothesis should also be examined in terms of their statistical significance and direction prediction. A structural model with good fit and with hypothesised paths which are significant and in the expected direction can be supported. The relationships among constructs must correspond to the theory suggesting their positive or negative directions. Like CFA1 models, there could be some alternative models with the same empirical results. Model diagnostics can be conducted in the same way as CFA1 models. The Chi-square (χ^2) GOF for a structural model is mostly larger than that for a measurement model because a measurement model usually has more estimated parameters than a structural model. That is why a CFA1 model can fit better than a recursive structural model (Hair *et al.*, 2014, pp.650-662).

When all paths among constructs in a model proceed in one direction (from the antecedent constructs to outcome constructs), the model is recursive. On the other hand, a non-recursive model includes reciprocal or feedback effects between constructs (Hair *et al.*, 2014). In a non-recursive model, any constructs are affected by some antecedent constructs and again affect the antecedent constructs (Byrne, 2010; Hair *et al.*, 2014). It is recommended to avoid non-recursive models with cross-sectional data because the models can have statistical identification problems (Hair *et al.*, 2014).

A structural model is a nested and parsimonious model of a CFA1 model in that fewer estimated paths are included in spite of the same number of constructs and items as the CFA1 model. Therefore, under some conditions such as a recursive model, adequate sample size and three items per construct, the identification of a CFA1 model can also lead to the identification of a structural model (Hair *et al.*, 2014).

A *post hoc* analysis is the performance of test of paths which were not included in an original theory. The analysis is quite common practice. However, any new relationships which *post hoc* analyses provide are only useful in the specification of potential model improvements. Therefore, it is not reasonable to utilise the *post hoc* analyses in theory testing. In this sense, any re-specification should be based on strong theoretical and empirical support (Hair *et al.*, 2014).

4.3.3 Multivariate analysis of variance

Analysing group differences can be categorised into the following univariate techniques and multivariate methods based on the number of dependent variables and the number of groups in independent variables (Hair *et al.*, 2014):

Table 4-2 Relationships between univariate and multivariate methods

Number of groups of independent variables	Number of dependent variables	
	One (Univariate)	Two or more (Multivariate)
Two groups (Specialised case)	*t* test	Hotelling's T^2
Two or more groups (Generalised case)	ANOVA	MANOVA

Source: Hair *et al.* (2014, p.669)

The *t* test and Hotelling's T^2 test can evaluate the difference between only two groups of independent variable whereas Analysis of Variance (ANOVA) and MANOVA can assess more than two group situations as well as the two group situations. The null hypothesis of the univariate techniques (*t* test and ANOVA) is that the average of a single dependent variable is equal across groups for independent variable whereas the multivariate methods (Hotelling's T^2 and MANOVA) hypothesise the equality of vectors of average on multiple dependent variables across the groups (Hair *et al.*, 2014).

Multivariate techniques are preferred because a series of separate univariate tests can inflate Type I error rates (Huberty and Morris, 1989; Hair *et al.*, 2014). Although MANOVA can be considered as an extension of ANOVA (Hair *et al.*, 2014), MANOVA is preferred to ANOVA in that MANOVA can identify whether groups differ along a combination of dependent variables whereas ANOVA can only identify whether groups are different along a single dependent variable (Field, 2009). MANOVA can also consider the relationship between the dependent variables however ANOVA cannot explain any correlations among the dependent variables (Field, 2009). MANOVA has greater power than ANOVA in identifying group differences because it can consider the correlations among dependent variables (Huberty and Morris, 1989). With relatively small dependent variables (five or fewer), the MANOVA is statistically more powerful than a single ANOVA (Hair *et al.*, 2014). In addition, MANOVA identifies the differences among underlying latent variables whereas ANOVA only identifies distinctions among groups on an observed variable (Huberty and Morris, 1989)

Therefore, MANOVA is more suitable than ANOVA in social sciences where most topics involve latent constructs (Warne, 2014). Furthermore, MANOVA and ANOVA represent sometimes different results such that although MANOVA indicates the differences of groups on a dependent variable, ANOVA does not show any differences among groups (Field, 2009). MANOVA is one of the most widely used multivariate statistical methods in the social sciences (Warne, 2014).

To achieve objectives d and e and to test hypotheses H_6 to H_9, this study adopts MANOVA. MANOVA tests whether groups according to shipping registered, vessel types, and contract periods differ along a combination of CSI1 and CSI2, or otherwise.

4.3.3.1 Assumptions of multivariate analysis of variance

The following assumptions should also be satisfied to perform MANOVA (Field, 2009; Hair *et al.*, 2014). Observations should have statistical independence among each other. Sample data should be collected randomly from the population of interest. The independence of observations can be guaranteed as much as possible by collecting the sample randomly. The dependent variables should be multivariately normal within each group. However, there is no direct test for multivariate normality. The identification of univariate normality for individual dependent variables can be a necessary condition for multivariate normality. Although the multivariate normality cannot be guaranteed by only the univariate normality, if the univariate normality can be identified across variables, any violation from multivariate normality can be considered inconsequential. The same correlation between any two dependent variables should exist in all groups. The equality of variance and covariance matrices between dependent variables across groups can be identified by Box's test. When group sizes are different, the inspection of this test is necessary. A non-significant Box's test implies that the matrices are the same. Because of the sensitivity of Box's test to multivariate normality, the multivariate normality of the data should be identified before the interpretation of the result of Box's test. The univariate tests of equality of variances across groups should be performed by Levene's test. Non-significance in Levene's test supports the assumption that the equality of variance is met.

In addition, significant correlation among all dependent variables should exist and the correlations can be assessed by Bartlett's test for sphericity (Hair *et al.*, 2014).

4.3.3.2 Considerations for multivariate analysis of variance

A sample size in MANOVA implies individual group sizes. The number of observations in each group should exceed minimally the number of dependent variables. A minimum of 20 observations in a group is practically recommended. Although unequal sample size per group can be easily accommodated by computer programs, it is better to maintain equal or similar group sizes (Hair *et al.*, 2014).

The acceptance or rejection of the null hypothesis that between-group differences do not exist is determined by MANOVA test statistics labelled "Multivariate tests" (Field, 2009). There are four MANOVA test statistics: Pillai's Trace (PT), Wilks's lambda (WL), Hotelling's Trace (HT), and Roy's Largest Root (RLR) (Field, 2009).

With regard to power, when group differences are converged on the first variate, the most powerful statistic is RLR and the second is HT followed by WL and PT. If group differences appear for more than one variate, the order shows the reverse pattern. In terms of robustness, the four test statistics are robust to infringements of multivariate normality (Olson, 1976). Roy's statistic is not robust to the violation of the equality of covariance matrix assumption (Stevens, 1979).

Although the four statistical measures suggest similar conclusions in most situations, when the dependent variables have strong interrelation on a single dimension, RLR would be the best choice (Hair *et al.*, 2014). Generally, if the assumptions of multivariate normality and homogeneity of covariance matrices are supported, PT is considered accurate and more robust with different group sizes (Field, 2009; Hair *et al.*, 2014). If the value of p for PT does not exceed 0.05, then the group differences can be identified in terms of the dependent variables (Field, 2009).

A main effect implies that an independent variable can define significant differences between two or more groups on the dependent variables (Hair *et al.*, 2014). The impact of independent variables can be evaluated by η^2. In other words, the relationship between independent and dependent variables can be quantified by η^2 (Thompson, 2006). The following two additional analyses should be implemented to define a main effect (Hair *et al.*, 2014). If several independent variables are included in the analysis, the significance test for the interaction terms of the independent variables should be conducted. The joint effect of the two or more independent variables is defined as the interaction term. The same criteria as the impact of main effects are used to evaluate the significance of an interaction term. If the interaction effect is identified as nonsignificant or ordinally significant, then the significance of the main effects can be estimated. If more than two groups in an independent variable exist, additional tests between the groups should be conducted to reveal which pairs of groups have statistically significant differences.

Power in MANOVA implies the probability that an independent variable can be identified by a statistical test. Power can be represented by 1-β (Type II error or beta error). The level of power is affected by the alpha (α) level, the effect size of the independent variables and the sample size of the groups (Hair *et al.*, 2014). Small sample size or small effect size may result in low power (Stevens, 1980). In addition, as the correlation between dependent variables is higher, the power of MANOVA becomes lower (Ramsey, 1982). A combination of the correlation among dependent variables and the effect size determines the power of MANOVA (Cole *et al.*, 1993). The desired value of power is over 0.8 (Hair *et al.*, 2014) and the value exceeding 0.7 is considered adequate (Stevens, 1980). If alpha level and the effect sizes of independent variables are small, then larger sample sizes per group should be used to maintain desirable levels of statistical power (Hair *et al.*, 2014).

ANOVAs can be utilised to follow up the outcomes of MANOVA. ANOVAs results are suggested in the table labelled “Tests of Between-Subjects Effects”. The values related to the univariate ANOVAs after the performance of MANOVA are the same as those obtained if one-way ANOVA was performed on each dependent variable (Field, 2009). The values of *p* in “Tests of Between-Subjects Effects” indicate whether there are significant differences between groups in terms of independent variables. However, there are some arguments for the use of ANOVA as a *post hoc* procedure (Warne, 2014) in that MANOVA analyses latent variables whereas ANOVA only deals with observed variables (Zientek and Thompson, 2009) and MANOVA and ANOVA address different research questions and sometimes produce different results with even the same data (Huberty and Morris, 1989). In fact, the results of MANOVA may have little or no direct substantive relation to the results of ANOVA (Huberty and Morris, 1989). A significant difference of MANOVA does not need to imply any significant effects in ANOVA (Warne, 2014).

The differences of pairs of groups across one or more dependent variables can be examined by *post hoc* tests. *Post hoc* tests are widely utilised because the tests make multiple comparisons easily. The Scheffé, Tukey's Honestly Significant Difference, Tukey's extension of the Fisher Least Significant Difference (Tukey LSD), Duncan's multiple-range test and the Newman-Keuls test are commonly used as *post hoc* tests (Hair *et al.*, 2014).

4.4 Summary

This chapter revealed that this research is in line with pragmatism in terms of both philosophical and methodological perspectives. A plan concerning how to collect and analyse data was described. With regard to statistical techniques, EFA and CFA1 are utilised to attain the research objectives a and b. A path analysis of SEM is adopted to achieve objective b in this research and to test hypotheses H_1 to H_5. EFA is again utilised for the calculation of CCSIs, namely for the accomplishment of the research objective c. MANOVA is chosen to attain the research objectives d and e and to test hypotheses H_6 to H_9.

Chapter 5 Instrument development

It cannot be overemphasised that a research instrument with desirable reliability and validity properties should be developed (Churchill Jr, 1979). Measures suitable for phenomena unique to an industry under examination need to be developed (Gundersen *et al.*, 1996). Scales imply a group of consistent questions which refer to indicators of a construct and “each rating question is often referred to as a scale item” (Saunders *et al.*, 2016, p.461). The process of scale development contains item creation and ensuing “content adequacy assessment” of each item however the content adequacy is often overlooked (Hinkin *et al.*, 1997).

In this context, because basic guidelines for developing items are already discussed in 4.3, in this chapter, the content adequacy assessment is mainly discussed to develop appropriate measures for the cooperative and collaborative relationship between shippers and shipping companies.

Section One and Two address the items generation based on expertise of 11 industrial experts and content analysis technique. Q-sorting technique is utilised to assess how well each item represents its corresponding construct in Section Three. The technique can also help to increase the content validity of this research. Finally, in Section Four, the instrument of this research is confirmed by pilot test. Through the pilot test, the content validity of the instrument is once again identified. In the section, how the measures of construct can reasonably be represented by the items is identified. In addition, the draft questionnaire is refined into the final version.

5.1 Content analysis

Although conducting qualitative data analysis has many, albeit not definitive, approaches like visual analysis, grounded theory, narrative analysis, discourse analysis and content analysis, there are a similar series of steps in the approaches. The following common four steps in qualitative analysis can be suggested (Wilson, 2014): transcribing data; reading and generating categories, themes and patterns; interpreting findings; and writing the report.

In other words, the commonality of qualitative data analyses includes reducing and coding data, developing patterns and categories, and looking for connections among the categories (Wilson, 2014).

Collis and Hussey (2009, p.164) describe that “content analysis is a method by which selected items of qualitative date are systematically converted to numerical data.” Meanwhile Easterby-Smith *et al.* (2015) note that “content analysis is an approach that aims at drawing systematic inferences from qualitative data that have been structured by a set of ideas or concepts” (p.188) and in spite of its interpretative and qualitative method, content analysis can bring quantifiable elements into the process because of its intrinsic positivist framework. In this sense, content analysis is often regarded as word frequency counts (Wilson, 2014) which assumes that the words that are most often referred imply that the greatest concerns are represented by the words (Stemler, 2001).

However, “content analysis has expanded to include interpretations of latent content” (Graneheim and Lundman, 2004, p.105) and this highly flexible method can be applied to various and different kinds of unstructured information (Bryman and Bell, 2003). In this vein, Graneheim and Lundman (2004) divide content analysis into a qualitative and a quantitative approach. They note that "Qualitative content analysis focuses on the subject and context and emphasises differences between and similarities within codes and categories" and also "the method deals with manifest and as well as latent content in a text" (p.111). "Content analysis can be used with all kinds of data including (but not limited to) company reports, observational records, interview transcripts and diaries and also can be used for conducting systematic literature reviews, for theory building, and for hypothesis testing" (Easterby-Smith *et al.*, 2015, p.188).

Dependence on coding and categorising of data has contributed to the extension of content analysis (Stemler, 2001). A code implies the label of a meaning unit which is words, sentences or paragraphs including aspects pertaining to each other through their context and content (Graneheim and Lundman, 2004). When conducting a content analysis, coding process is a crucial stage (Bryman and Bell, 2003). "The goal of coding is to fracture the data and rearrange it into categories that facilitate the comparison of data within and between these categories and that aid in the development of theoretical concepts" (Strauss, 1987, p.29, cited in Wilson (2014)). Coding scheme of content analysis has two elements such as a coding schedule and a coding manual (Bryman and Bell, 2003). "The coding schedule is a form which all the data relating to an item being coded will be entered and the coding manual is a statement of instructions to coders that specifies the categories that will be used to classify the text based on a set of written rules that define how the text will be classified" (p.202). Coding manual is very important in that it provides all categories for each dimension and guides how to interpret the dimensions and it can help a coder to code consistently. In terms of consistent coding, they especially emphasise that “coding must be consistent between coders (inter-coder reliability) and each coder must be consistent over time (intra-coder reliability)” (p.206).

Categories and subcategories are identified by coding and researchers can decide how to mark codes while there is no absolute approach to coding (Wilson, 2014). Krippendorff (1980, cited in Graneheim and Lundman (2004)) defines category as a group of content that shares a commonality and stresses that categories must have exhaustiveness and mutual exclusiveness. Exhaustiveness of categories implies that any data should not be excluded owing to absence of proper categories while mutual exclusiveness of categories signifies that any data should not fit into more than one category (Graneheim and Lundman, 2004). According to them, many sub-categories or sub-subcategories at different levels of abstraction are often contained in a category. Clear instructions on interpreting each dimension and clear units of analysis are also essential in content analysis (Bryman and Bell, 2003).

5.2 Measurement scales development

When it comes to the development of measurement scales, several standard procedures such as generating of an item pool and choosing of common format for items can be adopted. Scales can be developed by creating new scales, adapting existing scales, or using existing scales (Schrauf and Navarro, 2005).

Using or adapting scales is more efficient than developing new scales because thousands of scales measuring attitudes and personality dimensions have been developed since the 1930s when scaling skills were first created (Saunders *et al.*, 2016). According to them, adopting and adapting questions can help to assess reliability and the sources that the questions are from should be noted.

According to Schrauf and Nararro's (2005) advice, the initial 82 items which could be connected with constructs revealing cooperation and collaboration spirit and could be adopted to the relationship between shippers and shipping companies (as one of the inter-firm relationships in SCs and logistics), were compiled through extensive reviews of extant literature as shown in Table 3-1. The necessity to reduce the number of the incipient items was raised although it is recommended that the researcher should not be too preoccupied with the length of questionnaire (De Vaus, 2002).

With regard to the number of variables, through utilising parsimoniously selected variables based on conceptual and practical considerations, the highest ratio of the number of observations per variable should be acquired to prevent the chances of overfitting the data - "deriving factors that are sample-specific with little generalisability" (Hair *et al.*, 2014, p.100). Besides, completion of the large number of survey questions would be too costly and demanding on the respondents (Hair *et al.*, 2014). To reduce the number of items, the following careful considerations were given. The orders of construct were lessened from three to two because many orders of construct are inclined to increase the number of items. The one or two items representing best the first order constructs were chosen very carefully. At the same time, redundant and irrelevant items were deleted and also items having similar or the same meaning were integrated into one item.

5.2.1 Deletion of irrelevant and unclear items

Although the incipient list of 82 items was compiled from existing literature and theories related to cooperation or collaboration, it was not certain if the items could be applied to the shipping industry and whether their meaning is clear in the shipping context. Therefore, the initial 82 items were distributed to 11 industrial experts in the field of shipping industry in South Korea through email to ascertain whether the items can be applied to the relationship between the SC members or not. Comments on the representativeness and appropriateness of the questions should be initially requested from an expert or group of experts, which will be conducive to establishing content validity and will make necessary amendments of the questions possible before conducting a pilot test with a group similar to the final population (Saunders *et al.*, 2016).

The 11 experts who consist of six people (two directors, a general manager, a deputy general manager, two managers) engaging in coastal shipping (steel, oil and chemicals, heavy) and five people (a director, a general manager, a manager, two assistant managers) engaging in ocean-going shipping (container and bulk) respectively were requested to discard the items which they think are not appropriate in the SC and cannot clearly be understood. The practitioners were also requested to suggest individual opinions on their elimination of items. Based on their expertise, the deletion of the items was carried out according to the following two principles. Items with over 70 percent of respondents' agreement on the deletion are crossed out. Items which are presented as having unclear meanings caused by the usage of expansive, abstract, and ambiguous words are eliminated irrespective of the deletion agreement rate of the respondents.

In terms of 70 percent of deletion agreement rate, this research employed the agreement rate of sample by Ekinci and Riley (1999) and Boon-itt and Paul (2005) who applied at least 70 percent of the agreement rate of respondents in confirming whether a definition (a construct) exists or not in the process of Q-sorting.

Appendix 1 shows 36 items eliminated from the 82 initial items based on the industrial experts' opinions and according to the above principles.

Sixteen items -11, 16, 29, 30, 31, 33, 34, 36, 39, 43, 44, 45, 46, 48, 49, 53 - of the incipient items acquired over 70 percent of agreement rate on the deletion from the 11 respondents. The respondents proposed such reasons for the elimination that some items are irrelevant and cannot be applied to the SC and that for other items they could not find any cases in the SC.

For example, consider items 29 (shippers develop demand forecasts jointly with our firm), and 31 (shippers manage inventory jointly with our firm) which gained 73 percent and 82 percent of the deletion agreement rate respectively. Some experts suggested that inventory management and demand forecasts are entirely under the control of shippers and these items cannot be applied to the SC. With regard to demand forecasts, the explanation that shippers usually carry out forecasts of demand on their own and the demand forecasts could just be shared with shipping companies was added.

Further, some respondents indicated clearly that item 48 (shippers learn of the intentions and capabilities of competitors jointly with our firm) which obtained 73 percent of the deletion agreement rate could not be applicable to the SC. This is because shippers do not share information about their competitors with shipping companies and there is and never will be any case related to such information sharing.

Most respondents also pointed out that items 11 (our firm develops performance metrics and the resulting incentive together with shippers), 43 (shippers determine rewards according to the contribution jointly with our firm), 33 (shippers share their facilities and equipment with our firm), 34 (shippers share their knowledge, skill and technology with our firm), and 36 (shippers invest in other resources to support the relationship with our firm) have little possibility of being applied in the SC and seem to go too far.

Seventeen items - 2, 7, 12, 13, 14, 15, 21, 24, 28, 37, 50, 51, 55, 56, 58, 62, 67 - which were pointed out as having unclear meanings were discarded according to the above second principle. Specifically, items 2, 7, and 37 were eliminated because of their expansive meanings. The deletion of items 13, 14, 15, and 50 was caused by their abstract meanings. The ambiguous meaning of items 12, 21, 24, 28, 51, 55, 56, 58, 62, and 67 led to their elimination.

For instance, some respondents identified items 56 (shippers are willing to give their sincere apologies for their dishonesty) and 58 (we rely on our shippers not taking advantage of our firm) as having ambiguous meanings. That is why they were deleted. Although their deletion agreement rates are 64 percent and 27 percent respectively, the items were crossed out according to the second principle that an item which has clearer meaning should be chosen. The experts' opinions on items 56 and 58 can be reasonable and acceptable considering it is not easy to clearly understand what sincere apology and dishonesty (item 56) are and what taking advantage of (item 58) means.

It should also be noted that initial items 13, 14, 15 which are related to a code of conduct were crossed out. This might be because the respondents could not identify the exact meaning of a code of conduct and also they could not know exactly the internal code of conduct of shippers. The initial intent of the items is to know how well shippers observe their own ethics and rules with regard to commercial transaction.

With regard to item 24, some experts suggested the interesting opinion that the item is impracticable given that even shipping companies are not willing to share any additional rewards and benefits with shippers and vice versa.

Additionally, three items were deleted. Some experts indicated that items 61 (we believe that our shippers can carry out important projects related to our activities), 63 (we believe that our shippers can do things which we cannot do), and 64 (we believe that our shippers hold successful reputations in their field) are not relevant to the intent of this research to measure the extent to which shippers exhibit a cooperative and collaborative spirit towards shipping companies as a case study of collaboration in SCs. In fact, the items were initially intended to measure competence of shippers. However, the indication was so reasonable and acceptable that the items were crossed out.

5.2.2 Deletion of redundant and overlapping items

Appendix 2 shows the procedure of the selection of 25 items from the above remaining 46 items according to the following criteria. When an item has a similar or the same meaning as another item which encompasses it, the original item was regarded as redundant and was deleted. When two items overlap with each other, both items were merged into a new item which has almost the same meaning as the two items.

According to the first criterion, eight items (3, 4, 20, 26, 42, 54, 57, 72) were deleted because of their redundancy.

For instance, item three (shippers keep our firm informed about events or changes that may affect our firm) and item four (shippers provide feedback on our delivery services) have some similarity with item one (shippers would like to exchange relevant and timely information with our firm) and can be subsets of item one. In other words, relevant and timely information (in the case of item one) can subsume effective information about events or changes (in the case of item three) and shippers' feedback (in the case of item four).

Another example is that item 42 (shippers measure the contribution of our firm jointly with firm) can be incorporated into item 41 (shippers review the performance of our firm on a regular basis jointly with our firm) in that the contribution of shipping companies is necessarily measured by performance of shipping companies.

Twenty four items that have meanings which overlap with other items were merged into 11 slightly new items according to the above second criterion, which left 25 items remaining.

For example, item 59 (we rely on the attention and willingness of the top management of our shippers to maintain a good relationship with our firm) and item 60 (we rely on the attention and willingness of working group of our shippers to maintain a good relationship with our firm) were merged into the following slightly changed statement: “we rely on the attention and willingness of shippers to maintain a good relationship with our firm”. This is because the top management and the working group of a shipper can be recognised within one entity, i.e. “the shipper”, regardless of the hierarchical position within the shipper group.

In the case of item 74 (shippers discover new markets jointly with our firm), item 75 (shippers share new business plans or ideas with our firm) and item 76 (shippers try to expand overseas jointly with our firm), these were merged into the following sentence which has a similar meaning: “shippers try to share new business plans or ideas and expand new markets (including a foreign market) jointly with our firm”. The rationale of this combination is that a foreign market can be one of the new markets which can sometimes be regarded as new business plans or ideas.

The statement that “we have suffered defamation of character or illegal and unreasonable requests such as bribery, lavish entertainment and preferential treatment” was made from the combination of item 80 (we have suffered defamation of character or unilateral pressure from shippers) and item 81 (we have suffered illegal and unreasonable requests like bribery, treat and convenience). The intention of items 80 and 81 was to know the extent to which shipping companies have suffered from shippers' irrational behaviours irrelevant to business contract between them. That is why the merging of items 80 and 81 into the above statement which can measure the irrational behaviours of shippers can be justified.

5.2.3 Reconsideration of three deleted items

Despite the experts' opinions on the deletion of items, three eliminated items which are considered to be very important in measuring cooperative and collaborative spirit of shippers have been readopted.

First of all, item 62 (we believe that our shippers fulfil their business obligations) was resurrected as the following statement: "we believe that shippers fulfil their contractual obligations". This is because an expert suggested that item 62 is ambiguous and needs to be more specific and the item is essential to evaluate the extent to which shipping companies trust the competence of shippers.

Item 33 (shippers share their facilities and equipment with our firm) and 36 (shippers invest in other resources to support the relationship with our firm) were reselected and described in details although the items obtained 82 percent and 91 percent of agreement rate of item deletion from 11 industrial experts. This is because the case related to items 33 and 36 exists and the items are very important in measuring the attitude of shippers towards shipping companies.

In the summer of 2009, the author had a chance to conduct interviews with a shipping company A and its shipper B. Both companies agreed that B provided A with its docks for delivery of its freight and guaranteed a bank loan for the procurement of a vessel of A for ten years. Thanks to the support of B, A could focus on effective and safe delivery of B's freight. That is why items 33 and 36 were reselected. The researcher believes that the extent to which shippers are willing to share their resources with shipping companies is a very important indicator showing the cooperative and collaborative spirit of shippers towards shipping companies.

To be more specific and clear, items 33 and 36 were slightly amended as follows. Shippers are willing to share their facilities and equipment such as their docks, cranes, delivery vehicles with our firm (if shippers have the facilities and equipment) (in the case of 33). Shippers are willing to provide financial support such as guarantee of a bank loan required for procurement of vessels of our firm (if shippers have such financial capabilities) (in case of 36).

The revised items 33, 36 and 62 were included in the 28 items in Appendix 3 which also includes some revised items for clarity.

5.3 Assessment of content adequacy: Q-sorting

Q-sort technique can be utilised in the process of scale development and the technique is appropriate for dealing with the reliability and validity problems which subjectivity of a concept or a construct may cause (Boon-itt and Paul, 2005). More specifically, the convergent and discriminant validity of scales can be verified by the method (Moore and Benbasat, 1991). Q-sorting is conducive to finding concepts which have not been firmly established (Ekinci and Riley, 1999; Boon-itt and Paul, 2005) and to developing new scales (Segars and Grover, 1998). “It categorises scales, assigning the most appropriate statement to the measured construct while eliminating the meaningless one (content validity) in order to avoid an unambiguous variable definition” (Boon-itt and Paul, 2005, p.51).

Detailed instructions about Q-sort procedure should be suggested to respondents (i.e. judges) (Moore and Benbasat, 1991; Segars and Grover, 1998; Boon-itt and Paul, 2005) and respondents are asked to enunciate which construct is most closely connected to each scale item or which matching cannot be determined (Segars and Grover, 1998). Items as well as constructs can be provided to the respondents in the form of an index card (Moore and Benbasat, 1991; Ekinci and Riley, 1999) or on several pages or a single page (Segars and Grover, 1998).

Multiple rounds of sorting are not considered essential if construct validity is sufficiently verified by one round analysis (Segars and Grover, 1998). In terms of sample size or the number of respondents, the early studies suggested the ranges from 20 to 100 (Ekinci and Riley, 1999) and more. Kerlinger and Lee (1964, cited in Ekinci and Riley, 1999) argue that as many respondents as possible are desirable in Q-sorting.

When it comes to the application of the technique, the following should be considered (Ekinci and Riley, 1999). A group of definitions of each construct should be created through literature review or experts’ remarks. A group of statements apparently representing those definitions should be described. Sorting the statements into suitable definitions freely should be ensured through providing a not-applicable category among such definitions.

However, the definitions of each construct should not necessarily be provided to respondents. Rather only the draft statements relating to constructs should be given to respondents (Moore and Benbasat, 1991) or any predetermined number of categories may be withheld from respondents (Greenberg, 1986). With regard to the above non-applicable category, “a too ambiguous (fitting in more than one category) or too indeterminate (fitting in no category) definition can also be subsumed to ensure that the judges are not forced to fit any item into a particular category.” (Moore and Benbasat, 1991, p.201)

In relation to this technique, the following criteria determine whether a definition exists or not (Ekinci and Riley, 1999; Boon-itt and Paul, 2005): when a definition can be reasonably explained by at least two statements on which over 70 percent of the sample agree, it can be confirmed that the definition exists. With regard to the agreement rate of subjects, no consensus seems to exist; for example, Greenberg (1986) adopts at least 75 percent of the agreement rate unlike Ekinci and Riley (1999) and Boon-itt and Paul (2005).

For instance, Boon-itt and Paul (2005) distributed 29 statements corresponding to six definitions and a non-applicable category to 30 respondents consisting of academics and industrial experts. With regard to the criteria, they gave an example through a definition of relationship integration among the six definitions. Five statements were assumed to represent the definition of relationship integration. The survey showed that two among the five statements acquired over 70 percent of the agreement rate of the respondents - 80% (24/30) and 70% (21/30) respectively while three among the five statements received the rates of 63% (19/30), 50% (15/30), and 50% (15/30) respectively. Based on the result they concluded that the definition of relationship integration exists in the light of the criteria.

It is also noted that the results of Q-sorting could not be generalised to the population if the technique is not followed by CFA1 (Ekinci and Riley, 1999; Boon-itt and Paul, 2005). Therefore, this technique should not be regarded as a complete analysis but as one of the preliminary methods in the process of scale development (Ekinci and Riley, 1999).

5.3.1 The first round Q-sorting

Because such constructs as *transparency, mutuality* and *sustainability* in this research cannot be considered to be firmly established, the Q-sort technique was adopted.

The 28 items and six constructs which are regarded as embracing the items in Appendix 4 were emailed to 20 experts for the first round Q-sorting (12th April to 28th April 2016). The constructs and items were displayed to SC experts on three pages of script (including one-page of constructs and two-pages of items).

The experts were asked to select the items which best measure a construct. The 20 experts were comprised of four director-level civil servants who work in or have engaged with shipping industry policy in South Korea, five staff members of Korea Shipowners' Association (KSA1) for ocean-going shipping, four staff members of Korea Shipping Association (KSA2) for coastal shipping, five staff members of Korea Maritime Institute (KMI) and two professors researching into the shipping industry.

The constructs offered were *transparency, fairness, mutuality, trust, sustainability, power* and not-applicable (n/a). The “n/a” category was added to prevent the respondents from being forced to put any item into a particular construct. The outcome of the first round Q-sorting summarised in Table 5-1 below showed poor agreement rate of subjects.

Table 5-1 Outcome of the first round Q-sorting

	Total	Trans-parency	Fairness	Mutuality	Trust	Sustain-ability	Power
ARS (%)	54	45	63	31	50	44	96
NI/NIC	10/28	2/4	1/4	1/8	1/4	1/4	4/4

Note. ARS: Agreement Rate of Subjects, NI: The number of items with over 70% of ARS, NIC: Total number of items in the construct

According to the criteria of Ekinci and Riley (1999) and Boon-itt and Paul (2005), four constructs such as *fairness, mutuality, trust*, and *sustainability* were not explained by at least two items with over 70 percent of agreement rate of respondents, which meant the four constructs did not exist in the *status quo*.

Only two constructs such as *transparency* and *power* met the criteria and could be identified as “exist”. Only power showed all the four initial items acquired over 70 percent of the agreement rate: 100 percent (item 25), 90 percent (item 26), 100 percent (item 27), 95 percent (item 28) respectively. In the case of *transparency*, two of the four items obtained 70 percent (item one) and 75 percent (item three) of the agreement rate respectively. Some respondents pointed out that it was difficult to distinguish between items assumed to represent *trust* and *sustainability* as well as *fairness* and *mutuality*.

Considering the purpose of Q-sorting which is to identify the convergent and discriminant validity of scales (Moore and Benbasat, 1991), it is identified that the constructs and items in this research should be revised and additional Q-sorting needs to be conducted. Appendix 4 shows the outcome of the first round Q-sorting in detail.

The problems of the first round Q-sorting based on the opinions of some respondents are as follows. Even though the initial items were properly used in other fields, the items should cautiously be reutilised in the shipping industry. In other words, some items used in other fields should not be adopted in the shipping industry *per se* and should be adapted properly. The abstract and general explanation of a construct prevented the respondents from understanding well the exact meaning of the construct. Consequently, the respondents could not properly undertake the matching between constructs and items. Particularly careful attention should have been paid to the selection of words in items to avoid confusion.

The second and third problems can give some justifications for retaining rather than discarding the four constructs with less than 70% of the agreement rate such as *fairness, mutuality, trust,* and *sustainability* although the four constructs were revealed to be "non-existent" if following the criteria of Ekinci and Riley (1999) and Boon-itt and Paul (2005). In other words, more detailed explanations of constructs and a more cautious selection of words in items can increase the possibility of existence of the constructs.

Furthermore, as can be seen in Table 5-2 below, the answers of five respondents (two civil servants, two professors, and one researcher) with the highest agreement rate showed that the four constructs exist in light of the criteria. These are reasons why this research decided to choose the modification of items instead of the rejection of the four constructs.

Table 5-2 Five highest agreement rates in the first round Q-sorting

	Total	Trans-parency	Fairness	Mutuality	Trust	Sustain-ability	Power
ARS (%)	68	65	75	45	55	70	100
NI/NIC	14/28	2/4	2/4	2/8	2/4	2/4	4/4

Note. ARS: The Agreement Rate of Subjects, NI: The number of items with over 70% of ARS, NIC: The total number of items in the construct

Taking into account the above considerations, the following improvements were undertaken for the second round of Q-sorting:

The detailed explanations of constructs were prepared for the next Q-sorting round. For example, the *transparency* which was initially suggested as “From the viewpoints of shipping companies, the extent to which shippers try to maintain the relationship with shipping companies openly and transparently” was revised as follows: “the extent to which the relationship between shippers and shipping companies is open and transparent such as smooth communication, information sharing, clear setting up of the relationship between them through prior agreement”.

Some items which acquired a very low rate of correct classification, namely below 50%, were deleted or replaced by new items. The initial item two (shippers would like to keep in frequent contact with our firm through various channels) which was first intended to represent the construct of *transparency* obtained 25% of the agreement rate of respondents and seemed to make most respondents confuse with *sustainability* because of the expression “keep in frequent contact”. Therefore, the item was deleted and substituted by the following sentence: “shippers and our firm communicate smoothly with each other through various channels” to reveal well the construct of *transparency*.

In terms of the initial item four (shippers would like to settle cooperative and collaborative implementation plans or objectives by prior agreements with our firm) which aimed to measure *transparency* but received the second lowest rate of agreement (10%), the phrasing of “the joint settlement of cooperative and collaborative implementation plans or objectives” seemed to result in most respondents connecting the item with *mutuality*. Accordingly, the initial item four was classified into two new items including “the cooperative and collaborative relationship between shippers and our firm is understood clearly and transparently by prior agreements” (new item four) in *transparency* and “shippers and our firm, as even business partners, settle together common cooperative and collaborative implementation plans or objectives” (new item 13) in *mutuality*.

The initial item 12 (shippers are willing to dedicate personnel to managing the relationship with our firm) which showed 15% of the low agreement rate was deleted. This is because most respondents assigned this item to “not-applicable” or *sustainability* and also some of them judged this item as less important compared to other items in *mutuality*.

The initial item 14 (shippers are willing to listen to our firm’s difficulties and to help our firm deal with the difficulties) which received 20% of the correct classification rate - most respondents assigned this item into *sustainability* - was rectified to have a clearer meaning: “shippers are willing to assist our firm with overcoming the difficulties when our firm is faced with any difficulties”.

The initial item 15 (shippers are willing to review the performance of our firm on a regular basis jointly with our firm) which showed 45% of the agreement rate was revised to represent clearly a facet of *mutuality*: “shippers and our firm, as even business partners, review together the performance of our firm”.

The initial item 18 (we rely on the attention and willingness of shippers to maintain a good relationship with our firm) received 45% of the agreement rate. The low rate can be explained by that the expression “to maintain a good relationship” could make most respondents confuse *sustainability* with *trust* which it was first intended to connect with. Therefore, the item was amended more clearly to “we believe the good faith of shippers when it comes to the relationship between shippers and our firm” to show an attribute of *trust.*

The initial item 20 (we benefit from and are satisfied with the relationship with shippers) obtained 5% of the lowest agreement rate which is probably because most respondents considered satisfaction as *sustainability*. Therefore, the item was replaced by a simple and clear sentence: “we believe that shippers benefit our firm”.

Most respondents classified the initial item 23 (we have experienced the expansion of business with the help of shippers) into not-applicable and the initial item 24 (shippers try to share new business plans or ideas and expand new markets (including foreign markets) jointly with our firm) into *mutuality* and the two items acquired the same low agreement rate (25%). The following revision was conducted: the initial item 23 was deleted because of the ambiguous meaning of “the expansion of business” and the initial item 24 was divided into two sentences - “shippers try to maintain their relationship with our firm such as developing together new business plans or ideas” and “shippers try to enhance continuously their relationship with our firm such as expanding jointly new markets (including foreign markets)” to show manifestly the *sustainability* of the relationship between shippers and shipping companies.

In addition, some items which could be connected with other unintended constructs were deleted. Although the initial item 17 (we feel a bond with our shippers) showed 60% of the agreement rate, taking into consideration that some respondents classified the item into *sustainability* and others pointed out that a bond is not clear or abstract, the item was deleted and was replaced by “overall, we think shippers are trustworthy” to definitely represent *trust*.

Two items which might cause some confusion because of their inappropriate usage of words were rectified. The word ‘believe’ in the initial items 21 (we believe the relationship with shippers is stable) and 22 (we believe the relationship with shippers will last for a long time and strengthen over time) could lead the items to be connected with *trust*. That is why the word ‘believe’ was deleted in the two items.

Some items were modified to clarify their meanings related to their constructs irrespective of their agreement rates. The initial item nine (shippers agree on the importance of cooperation and collaboration with our firm and shippers are willing to understand our firm’s service well) which was first intended to represent *mutuality* and showed 55% of agreement rate was revised with “overall, shippers understand our firm’s services well and are willing to provide any necessary assistance". In terms of the items in *fairness*, the words 'just' and 'fair trade' were supplemented to each item, which was deemed to be suitable to indicate the construct more clearly. The items in *mutuality* had more distinguishable words such as 'assist', 'provide' and 'as even business partners' to denote the construct unquestionably.

Finally, in spite of the second lowest rate of agreement (10%), the initial item 13 (shippers are willing to provide financial support such as guarantee of a bank loan required for procurement of vessels for our firm (if shippers have such financial capabilities)) which was connected with *trust* by most respondents - this is probably because most respondents thought that shippers' trust towards shipping companies leads to financial support or "guarantee" implies trust. - was retained without any rectification in the light of its importance as discussed already in 5.2.3.

Appendix 5 and 6 show the constructs and items which were revised through the above procedure and sent to other experts for the second round Q-sorting.

5.3.2 The second round Q-sorting

The six constructs and 28 items in Appendix 6 were emailed to five experts for the second round Q-sorting. The experts consisted of two director-level public officials (one being in charge of coastal shipping policy and one being engaged with ocean-going shipping policy in South Korea), two professors related with shipping industry, and one staff member of KSA2.

With regard to the number of respondents, although Ekinci and Riley (1999) argued that the respondents from 20 to 100 are suitable for Q-sorting - this is why this research collected 20 experts' responses for the first round Q-sorting, Moore and Benbasat (1991) chose just four experts for one round of Q-sorting. Alternatively, they conducted multiple rounds of Q-sorting - specifically, four judges for the first and the second, five judges for the third, and four judges for the final round. However, the total number of respondents is short of the minimum number that Ekinci and Riley (1999) suggest. To put it another way, the unified criterion on the number of respondents in Q-sorting does not exist. Furthermore, Segars and Grover (1998) conducted just one round Q-sorting which recruited probably less than 20 respondents and fully verified the construct validity. Therefore, following the viewpoint of Segars and Grover (1998), any additional Q-sorting rounds are not conducted if the evidence of construct validity is fully verified at any round of Q-sorting.

The second round Q-sorting of this research was implemented from 4th May to 10th May 2016. The result of the second round Q-sorting is suggested in Table 5-3 below. The very strong overall agreement rate of 97% was calculated and all constructs and items satisfied the criterion of Ekinci and Riley (1999) and even the criterion of Greenberg (1986). Therefore, the second Q-sorting verified that the constructs of this research exist definitely and the discriminant and convergent validity of the constructs are expected to be very high. Furthermore, through this result, any additional Q-sorting rounds or extra stages for item refinement were not deemed necessary.

Table 5-3 Outcome of the second round Q-sorting

	Total	Trans-parency	Fair-ness	Mutuality	Trust	Sustain-ability	Power
ARS (%)	97	100	95	100	100	90	95
NI/NIC	28/28	4/4	4/4	8/8	4/4	4/4	4/4

Note. ARS: The Agreement Rate of Subjects, NI: The number of items with over 70% of ARS, NIC: The total number of items in the construct

5.4 Pilot test

Generally, when measures are developed or borrowed through a number of sources, a pre-test for the same types of respondents as population of interest should be conducted to screen the adequacy of items (Hair *et al.*, 2014). Pilot tests are needed to improve scales and to settle problems related to completion of the questionnaire (Taylor and Todd, 1995). Pilot tests should be conducted to refine the questionnaire and to acquire some evaluation of the validity of the questions and of the likely reliability of the data which will be later collected (Saunders *et al.,* 2016).

For instance, Chwelos *et al.* (2001) pilot test their questionnaire in two rounds to obtain content validity of all items. Moore and Benbasat (1991) assess a reliability of scales through two rounds pilot test of the overall instrument. As discussed in Appendix14.3, reliability implies consistency with which the robustness of questionnaires can be represented. Questionnaires with sufficient reliability can produce consistent findings regardless of differences of measured times and circumstances (Saunders *et al.*, 2016).

With regard to the number of people for a pilot test, Saunders *et al.* (2016) recommend responses from 10 to 200 and advise a pilot test to include major differences in research population. Powell (1992) conducts a pilot test of 30 firms to establish Cronbach reliabilities for his scales. He also compares subsequently Cronbach's alphas of the pilot test to those in field study to assess the robustness of his scales within different circumstances. Lombard *et al.* (2002) suggest that a good rule of thumb of sample size for a pilot test of reliability is 30. They also argue that proceeding to the full sample depends on whether the reliability level acquired through a pilot test is adequate or not.

Each completed pilot questionnaire should be checked if respondent understood and answered questions and if all instructions were followed correctly (Fink, 2013, cited in Saunder et al. (2016)). According to Bell (2014, cited in Saunders et al. (2016)), the following information related to a pilot questionnaire can be additionally obtained: the completion time of the questionnaire; the clarity of the instructions; unclear or ambiguous questions; questions that are difficult to answer; any major topic omissions; clearness and attractiveness of the layout.

As shown in Appendix 7, the pilot questionnaire of this research was emailed to 34 experts. The test was conducted from 30th May to 30th June 2016. The respondents were comprised of three academic experts (two professors and a PhD holder of KMI) in the SC and 31 practitioners. The practitioners were recruited to embrace evenly the category of shipping (costal and ocean-going shipping), various types of vessels (container, bulk, oil, LPG/LNG, product/chemical, general cargo, others) and different sizes of shipping companies.

The participants were asked to point out the completion time of the draft questionnaire, to highlight any ambiguous instructions and statements in the pilot questionnaire and to explain why, to describe their opinions concerning the best way to reduce the number of the types of vessels and finally to comment on any other issues. The 31 industrial experts were especially requested to fill in all questions of the pilot questionnaire to test their reliability.

Table 5-4 depicts the profile of the industrial experts and shows that the pilot test reflected well the differences in the population of interest. The respondents are evenly spread out in terms of the criteria of classification such as types of shipping and vessels, number of employees, position in a company, and working period in the shipping industry and company.

Table 5-4 Demographic characteristics of pilot test

Category	Num	%	Category	Num	%
Type of shipping			Number of employees		
Coastal shipping	18	58	Fewer than 100	15	48
Ocean-going shipping	13	42	100~199	4	13
			200~299	4	13
			More than 300	8	26
Type of vessels			Position		
Container ship	5	16	Staff	4	13
Bulk carrier	8	26	Assistant manager	9	29
Crude oil tanker	1	3	Manager	3	10
LPG/LNG tanker	1	3	Deputy department manager	3	10
Product/chemical carrier	9	29	Department manager	5	16
General cargo vessel	3	10	Director/Senior director	5	16
Tug and barge	3	10	CEO	2	6
Others	1	3			
Working period in shipping industry			Working period in the shipping company		
Less than 5 years	6	19	Less than 5 years	6	19
5~9 years	10	32	5~9 years	16	52
10~19 years	11	35	10~19 years	7	23
Over 20 years	4	13	Over 20 years	2	6

According to the participants, it took on average of 15 minutes to complete the draft questionnaire. Nothing unclear and ambiguous was discovered and there were no special comments except that laws related to fair trade should be named correctly and contract period which is regarded as a very important issue in relationship between a shipper and a shipping company was omitted.

With regard to a way to reduce the types of vessels, many respondents pointed out that considering the similarity of shippers, a *bulk carrier* and a *general cargo vessel* can be merged into a *bulk carrier* and also a *crude oil tanker*, a *LPG/LNG tanker* and a *product/chemical carrier* can be included in a *tanker group or category*. These comments on the types of vessels can later be utilised in subsequent relevant analyses. In addition, some revisions to the questionnaire were carried out to subdivide a *bulk carri*er and a *general cargo vessel* according to shippers. The items were again rephrased to capture appropriately the perception of shipping companies.

In Appendix 8, the final questionnaire which reflects the above revisions and two suggestions of the respondents such as exact law title and contract period is presented.

In terms of reliability of the draft instrument, the number of respondents of this pilot test satisfied the criteria of Lombard *et al.* (2002) and Powell (1992). The Cronbach reliabilities for scales were also satisfied. All scales had values over 0.7, which represent that all scales have internal consistency and show robustness. The Cronbach's alphas of these scales are presented in Table 5-5 below. Because Table 5-5 verified that adequate reliability level was acquired, as Lombard *et al.* (2002) suggested, the final questionnaire was emailed to potential respondents on the third of July 2016.

Table 5-5 Reliability of constructs in pilot questionnaire

Construct	Cronbach alpha
Transparency	0.925
Fairness	0.919
Mutuality	0.972
Trust	0.960
Sustainability	0.925
Power	0.907

5.5 Summary

This chapter described how the instrument for measuring inter-firm collaboration and for collecting data was developed. Most of the measurement scales were derived from extant literature and on the basis of the conceptual model in Chapter Three. The 28 items including four items representing power were identified by interview, content analysis, Q-sorting, and pilot test. The items were rectified for the purpose of this research. Only 24 items which four items related to power were excluded among the 28 items are utilised for the measurement of cooperation and collaboration and for further empirical analyses. This is because power was introduced as a detrimental factor of collaboration and only the 24 items except for the four items representing power were initially intended to compose collaboration. Seven point Likert-scale questions mainly comprised the questionnaire.

The next chapter shows the outcomes of data collection conducted with the questionnaire and the result of the data screening. Survey response profile and overall statistics for items are provided.

Chapter 6 Descriptive analysis

As described earlier, the main purpose of this research is to diagnose and evaluate the extent to which a SC consisting of shippers and shipping companies is cooperative and collaborative, as a case study of collaboration in SCs. In line with the purpose, the classification of vessel types has significance given that each vessel type is postulated to have its distinctive shippers. In this context, this chapter divides the types of vessel into four groups rather than the initial eight groups based on other cases and experts' opinions gleaned in the pilot test stage.

How the questionnaire survey was conducted is explained in Section Two. Through reflection of "Ineligible" and "unreachable" potential respondents, total and active response rates are computed.

Section Three addresses the purification process of data such as identification of outliers, missing data and unengaged attitude. How to deal with outliers, missing data and unengaged attitude is discussed.

Section Four identifies that non-response bias is not detected in the sample by extrapolation method for the test of non-response bias.

Section Five describes demographic data for the respondents. The characteristics of types of shipping registered and of vessels according to employee and contract period are also examined.

Finally, overall statistics for each item including mean, median, and standard deviation are provided in Section Six.

6.1 Re-classification of vessel types

This research first intended to sort vessel type into eight categories: container ship, bulk carrier, crude oil tanker, LPG/LNG tanker, product/chemical carrier, general cargo vessel, tug and barge, and others.

However, according to cargo type, UNCTAD (2016) categorises vessels into five types: oil tanker, bulk carrier, general cargo ship, container ship, other types such as gas carrier and chemical tanker.

Additionally, according to the criterion of the department for transportation of the UK (2016), vessel types can also be categorised into four: container, bulk carrier, tanker, and others. This classification exactly fits with experts' opinions on the category of vessel type which were suggested in the pilot test for this research.

Therefore, the category of the DFT (2016) is followed. For this, bulk carrier and general cargo vessel which were included in the first classification for vessel type are merged into bulk carrier. Crude oil tanker, LPG/LNG tanker and product/chemical carrier are re-categorised into tanker and finally tug and barge is integrated into others.

Table 6-1 shows the ocean-going shipping industry of South Korea in terms of the new classification. Based on MOF's internal data, 32 companies managing other types of vessels simultaneously were detected. Considering the 32 companies, the number of companies in the population (183) can be increased to 218, whereas the total GT and total number of vessels remain steady.

Table 6-1 Present condition of ocean-going shipping in South Korea

Classification	Number of companies	%	Total GT	%	Total number of vessels	%
Container ship	17	7.8	13,570,859	21.5	311	19.5
Bulk carrier	118	54.1	35,919,685	57.0	789	49.4
Tanker	65	29.8	13,159,419	20.9	422	26.4
Others	18	8.3	335,095	0.5	74	4.6
Total	218		62,985,058		1,596	

Source: Adapted from MOF (2016a)

As of late May 2016, the coastal shipping industry is comprised of 723 companies (MOF, 2016a). Among these companies, private companies are excluded for this research. This is because a private company represents a relatively small portion of GT in coastal shipping and in practice, most of them are small businesses and it is almost impossible to contact them and also it is very difficult to identify whether the companies actually manage their business or not. Therefore, a census was considered impossible and the sample is restricted to corporations (420) among all coastal shipping companies (723).

Table 6-2 represents the assortment of the coastal shipping industry by kinds of companies. The classification, especially the proportion, exactly corresponds to MOF's (2016b) statistics.

Table 6-2 Composition of coastal shipping in South Korea

	Number of companies	%	Total GT	%	Total number of vessels	%
Private Company	303	42	248,703	13	732	35
Corporation	420	58	1,663,408	87	1,331	65
Total	723		1,912,111		2,063	

Source: Adapted from MOF (2016a)

Taking into account of 41 corporations operating other types of vessels simultaneously, the number of corporations can be expanded to 460 from 420 as shown in Table 6-3. The table depicts the coastal shipping industry of South Korea according to the above new classification. In coastal shipping, others show a high proportion in terms of the number of companies, the total GT, and the total number of vessels. This is because others include tug and barge vessel which has the figures of 233 (companies), 845,844 GT, and 876 (vessels) respectively.

Table 6-3 Present condition of corporations in coastal shipping

Classification	Number of companies	%	GT	%	Number of vessels	%
Container ship	0	-	0	-	0	
Bulk carrier	81	17.6	505,418	30.4	157	11.8
Tanker	116	25.2	283,266	17.0	235	17.7
Others	263	57.2	874,724	52.6	939	70.5
Total	460		1,663,408		1,331	

Source: Adapted from MOF (2016a)

6.2 Questionnaire survey and response rate

This research conducted email questionnaire survey from third July to ninth September 2016. The email with the attached questionnaire was distributed to 183 ocean-going shipping companies and 241 coastal shipping companies respectively. The questionnaire was distributed to the appropriate respondents who could be expected to contact with and have the sufficient knowledge about shippers in the shipping companies.

In the case of ocean-going shipping, the entire contact information could be acquired through the KSA1. However, contact information containing only 241 corporations among the 420 corporations in coastal shipping, already mentioned in Section One, could be obtained through the KSA2.

During the period, to improve the response rate two reminder emails were sent out to and two reminder phone calls were made to potential respondents.

Out of the returned 174 responses (89 ocean-going and 85 coastal respectively), 167 responses were usable because one response had missing data and six showed unengaged attitude. Missing data and unengaged attitude are detailed in Section Three.

If the returned responses were calculated in terms of the number of companies, the total number of companies which participated in this research was 150 (75 ocean-going and 75 coastal).

Table 6-4 depicts the response rate of this research based on the number of companies which provided 167 usable responses.

In Table 6-4, “Ineligible” refers to the number of companies which did not meet this research’s requirements (Saunders *et al.*, 2016) such as no direct contract with shippers (due to managing only charter) and no relationship with Korean shippers. “Unreachable” implies responses which cannot be represented in this research data (Saunders *et al.*, 2016) due to the wrong email address and telephone number and inability to contact with related persons. In addition, some companies refused to answer the questionnaire giving several reasons such as no time and fear of shippers’ response and without any special reasons.

According to Newman’s (2014) calculation for response rate, the total response rate of this research was 25.5% and active response rate was 39.0%. “Unreachable” in coastal shipping refers to the number of corporations (179) which could not be contacted because of unavailability of their contact information and 16 unreachable corporations due to the wrong telephone number.

Table 6-4 Total and active response rate of this research

	Ineligible (A)	Unreachable (B)	Responsed company (C)	Total Sample (D)	Total response rate (%) [C/(D-A)]	Active response rate (%) [C/(D-A-B)]
Ocean-going	9	9	75	183	43.1	45.5
Coastal	5	179+16	75	420	18.1	34.1
Total	14	204	150	603	25.5	39.0

6.3 Data screening

As already mentioned in Section Two, a total of 174 initial responses (85 coastal shipping and 89 ocean-going shipping respectively) were collected for analyses. To establish a more decent analysis, data screening for missing values, outliers and unengaged responses was conducted.

An outlier means a markedly different observation from the other observations (Field, 2009; Hair *et al.*, 2014). The mean can be biased and the standard deviation can be inflated by the existence of outliers and the procedure for detecting outliers is necessary (Field, 2009).

There are two types of outlier: a univariate outlier which has an extreme value on a variable and a multivariate outlier which has extreme values on two or more variables (Kline, 2011).

Univariate outliers can be detected by a graph such as a histogram or a boxplot and z-scores (Field, 2009). If the standard score of an observation is greater than 2.5 (small sample size with 80 or fewer observations) or 4 (larger sample sizes), the observation can be designated as an outlier (Hair *et al.*, 2014).

Multivariate outliers are commonly detected by the value of the squared Mahalanobis distance (D^2) for each case (Byrne, 2010). Mahalanobis measure shows each observation's distance in standard deviation units from the centroid (the sample means for all variables) (Byrne, 2010; Kline, 2011; Hair *et al.*, 2014). Under the assumption of normal distribution with large sample, D^2 has a central chi-square distribution having the same degrees of freedom as the number of variables (Kline, 2011). An observation with higher D^2 value or a low p value has a higher possibility of becoming an outlier (Kline, 2011; Hair *et al.*, 2014). When it comes to the level of statistical significance for D^2, it should be set conservatively such as $p < 0.001$ (Kline, 2011) and 0.005 or 0.001 (Hair *et al.*, 2014). To put it another way, a case with p value less than 0.001 cannot constitute the case coming from the same population as the rest of the cases (Kline, 2011).

Nevertheless, there are many suggestions with regard to retention or deletion of the outliers. Outliers should be dealt with considering how representative they are of the population and should be deleted only if there is demonstrable proof that they cannot represent any cases in the population. This is because deletion of outliers can lead to improvement of the multivariate analysis whereas it can sacrifice generalisability of the analysis (Hair *et al.*, 2014).

According to Graus and Coppen (2016), an unengaged response means the response by the respondent who chooses the same one answer for all items and this type of responses have a standard deviation of 0. Although unengaged responses can be usually detected by values of standard deviation for each case, the criterion on the value is not unified. For example, Ibrahim *et al.* (2015) delete cases with a standard deviation of less than 0.7 whereas Esteves and Lopes (2016) exclude five cases having the value of less than 0.5. Furthermore, Graus and Coppen (2016) suggest a more generous value of 0.0 which is followed by this study.

Among the 174 responses, missing values were identified in one case. This study adopted deletion of the case although mean or median values can be replaced into the missing columns.

In terms of unengaged responses, six cases with a standard deviation of 0.0 were detected and deleted for further analyses. The deleted seven cases were all included in the coastal shipping.

To identify outliers, this research used standard scores for all observations and did not detect any outlier. All z-scores were below the threshold of |3| (Byrne, 2010), |3.29| (Field, 2009) and |4| (Hair *et al.*, 2014). This result could be consistent with Santos-Rodrigues *et al.*'s (2010) statement that if data are based on Likert scale, any comment on the outlier is not necessary. Any answer on Likert scale does not seem to represent the true meaning of outlier behaviour.

As shown in Appendix 9, in terms of multivariate outliers eight observations (107, 31, 74, 14, 101, 116, 154, 106) were identified as outliers with *p* value less than 0.001 through D^2 test. The eight cases were decided to be retained because any evidence that the eight outliers were illegitimately included in this data could not be found (Osborne and Overbay, 2004). To put it another way, this research followed Hair *et al.*'s (2014) thoughtful and balanced position on how to deal with outliers.

6.4 Non-response bias

Non-response bias implies error in findings when respondents do not participate in a study or respond to questions (Saunders *et al.*, 2016). Differences between respondents and non-respondents can cause non-response bias and it is necessary to test the difference prior to data analysis (Tharenou *et al.*, 2007). How the entire sample would have responded should be identified through verifying that respondents do not differ substantially from non-respondents. This is an important step for the generalisation of the sample to the population (Armstrong and Overton, 1977).

An efficient way to avoid the risk of non-response bias and to increase generalisability is to increase response rate (Armstrong and Overton, 1977; Dillman, 1991; Saunders *et al.*, 2016). The impracticability of making comparisons between respondents and non-respondents about variables in a study makes the response rate the general proxy for non-response error (Dillman, 1991). On the other hand, an empirical relationship between non-response bias and response rate is not fully supported and there is little empirical evidence for the concept that high non-response bias is caused by a low response rate or that a high response rate reduces the risk of non-response bias (Groves, 2006). However, Groves (2006) does not disregard the importance of high response rates in the sampling paradigm in good quality surveys.

The methods for estimating non-response bias can largely be categorised into the following three ways: comparison with known values for the population, subjective estimates and extrapolation methods (Armstrong and Overton, 1977).

Groves (2006) suggests the following ways to assess non response bias. Where comparison of response rate between subgroups by age, race and gender reveals that subgroups have cognate response rates, it can be said that non-response bias does not exist. Comparison of values of respondents and non-respondents based on variables in an external data set is a common method in health research in which individual medical records exist. Comparison of estimates which responses produce with those from external and reliable sources is the most common method of testing for non-response bias and if both estimates are similar, credibility of a survey can be established. Comparison of several estimates of respondents computed after dividing respondents into subgroups which are supposed to have different non-response bias is possible; if a researcher has information about the process of data collection, this method is easy and convenient. Finally the extent of non-response bias which a post-survey adjustment might eliminate could be computed.

To test for non-response bias, this research utilised the extrapolation method. This is because information on the process of data collection for this research is well arranged and prepared. The most common types of extrapolation are using successive waves of a questionnaire and time trends (Armstrong and Overton, 1977).

There could be many ways to divide respondents into subgroups whilst this research separated respondents into early respondents and late respondents and compared their responses - this technique is called *wave analysis* (Saunders *et al.*, 2016). The rationale for the comparison is that the respondents measured after a great amount of effort or who responded later would be more similar to non-respondents.

With established process data such as the number of call attempts and follow-up mails and based on time trends (Armstrong and Overton, 1977), non-response bias was tested. Around the first and last quintiles of the total usable responses (167) were compared each other. The outcomes of independent samples *t*-test for 24 item variables showed no significant differences at the 0.05 significance level between the first 30 and last 30 respondents. The results identified that the sample data do not have any non-response bias.

6.5 Survey response profile

As shown in Table 6-5, across the sample, the respondents vary in terms of type of shipping registered, type of vessel, work experience, job title, firm size and contract period. Respondents come from costal shipping (46.7%) and ocean-going shipping (53.3%).

In terms of type of vessel, 39.5% of the respondents work with bulk carriers. Sixteen container companies account for almost all of the population of the container industry in South Korea. Most respondents (72.4%) have over ten years of shipping experience; 21.6% hold executive level positions (CEO/senior director/director) and 67% hold the positions of manager or above.

In South Korea, the number of full-time employees has been one of the criteria for dividing firms into large or small and medium groups. Firms with less than 300 full-time employees or with equal to and less than eight billion Korean Won of capital or sales have been usually grouped into a small and medium category (Prajogo and Hong, 2008). However, from 2015, the criteria were unified into average or total sales given that the indicators can be arbitrarily fabricated and cannot fully reflect the growth of a firm. A shipping company with equal to or less than eight billion Korean Won of the sales is defined as a small and medium sized business by “framework act on small and medium enterprises” (SMBA, 2017). Therefore, it seems more reasonable to refer to the number of permanent staff, especially including the previous criterion of 300, as a complement to estimate firm size. This research, at first, intended to segment the groups of the number of employees in more detail to mirror the current state of employment of shipping industry as much as possible given that employment is a hot issue and a survey concerning the number of employees has rarely been conducted. As seen in questions 3-10 and 4-6 in Appendix 8, the initial classification according to the permanent employees was eight groups which included the 300 criterion. However, the survey showed that the groups of 100-149 (frequency 14), 150-199 (7), 200-249 (3), and 250-299 (4) accounted for very small portions of the sample. That is why the groups of 100-149 and 150-199 were merged into a new group of 100-199 and the groups of 200-249 and 250-299 were absorbed into the new group of more than 200 as shown in Table 6-5. For reference, responses with more than 300 full-time employees comprised 18 (11%). The table shows that shipping companies employing 10 to 99 staff explain 61.6% and 15% employ more than 200 staff.

Most of the companies (66.4%) have relatively short-term contract periods (less than 1 year and 1-2 years). Long-term contracts of more than 10 years comprise 16.8%. Demographic information in Table 6-5 such as work experience in shipping and job title demonstrates that the respondents have sufficient knowledge about the shipping industry to participate in this research.

In addition, averages of vessel number and GT of sample are 8.7 and 258,539 GT respectively. The minimum numbers of vessels and GT are 1 and 130 GT and the maximum numbers of vessel and GT are 77 and 4,728,542 GT respectively.

Table 6-5 Demographic data for the respondents (167 responses)

Variables	Frequency	Percentage
Type of shipping registered		
Coastal shipping	78	46.7
Ocean-going shipping	89	53.3
Type of vessel		
Container	16	9.6
Bulk carrier	66	39.5
Tanker	51	30.5
Others	34	20.4
Work experience		
Less than five years	18	10.8
5-9 years	28	16.8
10-19 years	90	53.8
Over 20 years	31	18.6
Job title		
Staff/Assistant manager	19	11.4
Manager/Deputy department manager	54	32.3
Department manager	58	34.7
(Senior) Director/CEO	36	21.6
Number of employees		
Fewer than 10	18	10.8
10-49	60	35.9
50-99	43	25.7
100-199	21	12.6
More than 200	25	15.0
Contract period		
Less than 1 year	55	32.9
1-2 years	56	33.5
3-9 years	28	16.8
More than 10 years	28	16.8

6.5.1 Characteristics of types of shipping registered by employee and contract period

As demonstrated in Table 6-6, the numbers of coastal shipping companies with employees of less than 50 (64.1%) are about double compared to the numbers of ocean-going (31.5%). Only 14.1% of coastal shipping companies have employees of more than 100 whereas 39.3% of ocean-going shipping companies have the same number of employees. This result corresponds with the MOF's (2016a) data that coastal shipping consists of relatively small businesses. The contract period of the ocean-going shipping industry is relatively shorter than that of the coastal shipping industry. Of coastal shipping companies, 61.5% have contracts of two years or less compared with 70.8% of ocean-going shipping companies.

Table 6-6 Demographic data of types of shipping registered by employee and contract period

Types of shipping	Employee			Contract period		
	Category	Frequency	%	Category	Frequency	%
Coastal shipping	< 10	15	19.2	< 1 year	18	23.1
	10-49	35	44.9	1-2	30	38.4
	50-99	17	21.8	3-9	18	23.1
	100-199	7	9.0	≥ 10	12	15.4
	≥ 200	4	5.1	Sub total	78	100
	Sub total	78	100			
Ocean-going	< 10	3	3.4	< 1 year	37	41.6
	10-49	25	28.1	1-2	26	29.2
	50-99	26	29.2	3-9	10	11.2
	100-199	14	15.7	≥ 10	16	18.0
	≥ 200	21	23.6	Sub total	89	100
	Sub total	89	100			
Total	< 10	18	10.8	< 1 year	55	32.9
	10-49	60	35.9	1-2	56	33.5
	50-99	43	25.7	3-9	28	16.8
	100-199	21	12.6	≥ 10	28	16.8
	≥ 200	25	15.0	Total	167	100
	Total	167	100			

6.5.2 Characteristics of vessel types by employee and contract period

Table 6-7 represents the characteristics of the types of vessel in terms of employee and contract period. Half of the container companies have more than 200 employees whereas other types of vessel companies show the highest proportion in 10-49 employees. With regard to contract period, all container companies have short-term contracts (less than 1 year or 1-2 years). Other vessel types show a similar trend however over 30% of bulk carriers have long-term contracts with shippers of more than 10 years.

Table 6-7 Demographic data of vessel types by employee and contract period

Types of vessel	Employee			Contract period		
	Category	Frequency	%	Category	Frequency	%
Container	< 10	-	-	< 1 year	12	75
	10-49	3	18.8	1-2	4	25
	50-99	2	12.4	3-9	-	-
	100-199	3	18.8	≥ 10	-	-
	≥ 200	8	50.0	Sub total	16	100
	Sub total	16	100			
Bulk	< 10	5	7.6	< 1 year	20	30.3
	10-49	22	33.3	1-2	17	25.8
	50-99	21	31.8	3-9	9	13.6
	100-199	11	16.7	≥ 10	20	30.3
	≥ 200	7	10.6	Sub total	66	100
	Sub total	66	100			
Tanker	< 10	11	21.5	< 1 year	9	17.6
	10-49	19	37.3	1-2	22	43.1
	50-99	7	13.7	3-9	14	27.5
	100-199	6	11.8	≥ 10	6	11.8
	≥ 200	8	15.7	Sub total	51	100
	Sub total	51	100			
Others	< 10	2	5.9	< 1 year	14	41.2
	10-49	16	47.1	1-2	13	38.2
	50-99	13	38.1	3-9	5	14.7
	100-199	1	2.9	≥ 10	2	5.9
	≥ 200	2	5.9	Sub total	34	100
	Sub total	34	100			
Total	< 10	18	10.8	< 1 year	55	32.9
	10-49	60	35.9	1-2	56	33.5
	50-99	43	25.7	3-9	28	16.8
	100-199	21	12.6	≥ 10	28	16.8
	≥ 200	25	15.0	Total	167	100
	Total	167	100			

6.6 Overall statistics for items

The mean and median scores for the items of cooperation and collaboration are represented in Table 6-8. The mean and median scores range from three to five. The items for TRA and SUS are rated closer to four by respondents. The means of items for FAI range from 3.54 to 4.46. Most of the mean values of items for MUT range from 3.0 to 3.99 except for MUT2 with a score of 4.28. The scores of items for TRU show relatively higher values exceeding 4.0. TRU3 (*We believe that shippers fulfil their contractual obligations*) had the highest mean value of 4.86 whereas MUT3 (*shippers are willing to provide financial support such as guarantee of a bank loan required for procurement of vessels for our firm*) has the lowest value of 3.20.

Table 6-8 Overall descriptive statistics for items

Items	%							Mean	Median	SD
	1	2	3	4	5	6	7			
TRA1	2.40	13.77	14.37	23.35	22.16	20.36	3.59	4.25	4	1.49
TRA2	3.59	13.17	14.97	23.35	23.95	16.77	4.19	4.18	4	1.51
TRA3	4.19	14.97	20.36	19.76	23.35	14.97	2.40	3.98	4	1.50
TRA4	4.79	13.17	17.37	19.76	24.55	15.57	4.79	4.12	4	1.56
FAI1	1.80	10.18	12.57	23.35	26.35	19.16	6.59	4.46	5	1.46
FAI2	4.79	10.78	8.98	21.56	31.14	17.96	4.79	4.37	5	1.51
FAI3	12.57	14.97	14.37	25.75	18.56	9.58	4.19	3.68	4	1.65
FAI4	11.38	19.76	15.57	25.15	17.37	6.59	4.19	3.54	4	1.61
MUT1	6.59	15.57	17.96	26.35	17.96	11.38	4.19	3.84	4	1.55
MUT2	5.39	11.38	14.97	17.96	24.55	20.36	5.39	4.28	5	1.60
MUT3	19.16	22.75	17.96	17.37	8.98	9.58	4.19	3.20	3	1.74
MUT4	10.78	21.56	23.95	17.96	14.37	7.78	3.59	3.41	3	1.59
MUT5	10.18	19.16	18.56	23.95	17.37	8.38	2.40	3.54	4	1.55
MUT6	8.38	20.96	17.37	24.55	14.37	11.98	2.40	3.61	4	1.57
MUT7	5.39	16.77	22.16	19.76	21.56	11.38	2.99	3.81	4	1.52
MUT8	11.98	19.76	22.16	21.56	11.98	8.98	3.59	3.43	3	1.61
TRU1	2.40	5.99	12.57	26.35	28.14	17.96	6.59	4.52	5	1.38
TRU2	2.99	6.59	14.97	28.14	26.95	14.37	5.99	4.37	4	1.39
TRU3	1.80	3.59	8.98	23.35	25.15	29.34	7.78	4.86	5	1.34
TRU4	1.80	5.39	11.38	23.35	26.35	22.75	8.98	4.71	5	1.41
SUS1	1.80	5.39	12.57	31.14	26.95	19.16	2.99	4.46	4	1.27
SUS2	4.79	6.59	14.97	28.74	22.16	17.37	5.39	4.31	4	1.47
SUS3	2.99	13.17	23.95	25.15	17.96	13.77	2.99	3.95	4	1.43
SUS4	6.59	15.57	21.56	22.75	18.56	10.78	4.19	3.80	4	1.55

6.7 Summary

Descriptive analysis was examined in this chapter. For further analyses, vessel types were re-grouped into four: container, bulk, tanker, others. Total and active response rates were 25.5% and 39% respectively. Through data screening, 167 responses remained. The *t*-test identified that non-response bias is not a great concern. Demographic data in terms of the number of employees and contract periods was detailed given that a survey concerning the two variables has rarely been conducted in South Korea. Overall statistics for items indicated that shipping companies believe most strongly in the fulfilment of contractual obligations of shippers (mean 4.86) whereas they think that the financial support from shippers is insufficient (mean 3.2). The next chapter reports empirical analyses of the 167 responses and provides results of the analyses.

Chapter 7 Empirical analysis

How sample data fit with major multivariate statistical assumptions such as normality and homoscedasticity should be evaluated before undertaking further statistical analyses (Hair *et al.*, 2014). Hence, the assumptions are first tested in Section One. Section Two describes results of EFA. EFA is utilised for further purification of the data. According to recommendations of authors (Osborne and Costello, 2009; Pedhazur and Schmelkin, 2013), EFA is conducted with ML and oblique rotation method (Direct Oblimin). EFA also plays an important role in calculating the weights of items and factors as well as in extracting common factors. Section Three describes first order factor measurement models for cooperation and collaboration supported in terms of model fit, validation, reliability, and unidimensionality. The existence and efficiency of second order constructs i.e. cooperation and collaboration are also verified by target coefficient (T) and model fit. Common method bias is complementally tested by Widaman's (1985) comparison of three models. In Section Four, through structural model test, the acceptance and rejection of the hypotheses from H_1 to H_5 is revealed. In Section Five, weights for calculation of the CCSIs are computed based on EFA. The weights of items and sub-constructs of both cooperation and collaboration are provided respectively. With the weights, overall CCSIs of the shipping industry and relevant CCSIs along with types of shipping registered, vessel types, and contract periods are computed. Finally, by employing MANOVA, the differences of individual CCSIs according to the above variables are compared. The results of MANOVA test determine the acceptance or rejection of hypotheses from H_6 to H_9.

7.1 Tests for major statistical assumptions

7.1.1 Test for normality

Normality refers to the degree to which sample data are normally distributed and is important in that *F* and *t* statistics assume normality. Normality can also be divided into univariate and multivariate normality. If a variable has multivariate normality, the variable can also be called univariate normal (Hair *et al.*, 2014). In other words, univariate normality is a necessary condition for multivariate normality but not sufficient (DeCarlo, 1997). Therefore, although univariate normality is identified, we cannot make a conclusion that the distribution is multivariate normal (West *et al.*, 1995).

The normality of a distribution can be discriminated by skewness and kurtosis (Field, 2009). Skewness means the balance of the distribution and left-shifted distribution means positive skewness whereas right-shifted distribution is called negatively skew (Hair *et al.*, 2014). Kurtosis refers to the extent to which a distribution is peaked or flat and scores agglomerate at the ends of the distribution (Field, 2009). A distribution with many scores in the tails and pointy shape is called positive kurtosis whereas a distribution with few scores in the tails and flatter shape than normal distribution constitute negative kurtosis (Field, 2009). The values of skewness and kurtosis of normal distribution is 0 (Field, 2009; Hair *et al.*, 2014).

Univariate normality can be identified by graphical analyses (histogram, normal P-P plot and Q-Q plot provided by statistical package such as SPSS), and statistical tests such as using statistic z-value for the skewness and kurtosis and the Kolmogorov-Smirnov test and Shapiro-Wilks test (Field, 2009; Hair *et al.*, 2014). In the case of z-values for skewness and kurtosis, the thresholds of absolute z-value are 1.96, 2.58, and 3.29 at $p < 0.05$, $p < 0.01$ and $p < 0.001$ respectively. If a z-value is greater than the above critical values at the respective significance level, it can be said that the distribution is not univariate normal. In a large sample (200 or more), it is recommended to focus on the statistics values of the skewness and kurtosis rather than their significant values because the large sample brings about the small standard errors which causes exaggerated significant values (Field, 2009).

With regard to multivariate normality, even though a direct test for multivariate normality is not available (Hair *et al.*, 2014), there is some research to identify the multivariate normality. Multivariate kurtosis is a more important concept than multivariate skewness because skewness has the tendency to affect means whereas kurtosis has an impact on variances and covariances (DeCarlo, 1997) which SEM is based on (Byrne, 2010). Based on the multivariate and univariate kurtosis values as well as their critical ratio (i.e. z-value) for each item provided by AMOS, West *et al.* (1995) suggest that kurtosis values for each variable equal to or greater than 7 imply deviation from univariate normality. In terms of multivariate normality, if multivariate critical ratio is greater than 5, the data can be considered as a non-normal distribution (Bentler and Wu, 2005).

The adequate sample size of this research led to the choice of z-score method to test univariate normality. Appendix 10 shows values of skewness and kurtosis including z-value of the data by SPSS. Although three variables (FAI2, MUT3, TRU3) are identified as having non-normal distribution at $p < 0.01$ in terms of skewness, z-values of all variables in terms of skewness and kurtosis shows univariate normality at $p < 0.001$ (i.e. below |3.29|).

Univariate normality can also be identified in Appendix 11 which shows assessment of normality by AMOS. The absolute values of skewness and kurtosis below 7 represent univariate normality for all variables of this research (West *et al.*, 1995). However, multivariate normality could not be identified because of the value of multivariate critical ratio (30.119) which is greater than the criterion 5 suggested by Bentler and Wu (2005). In spite of the multivariate non-normality of this research, if all variables correspond to univariate normality, any deviations from multivariate normality are usually considered as negligible. Therefore, considering the additional practical reason of non-existence of a direct test for multivariate normality, most researchers' concentration on the test for univariate normality of all variables is understandable and reasonable (Hair *et al.*, 2014).

This research follows Hair *et al.'s* (2014) view on multivariate normality and does not examine any other topics related to the multivariate normality such as remedies for non-normal distribution through data transformation and bootstrapping.

7.1.2 Test for homogeneity of variance

Homoscedasticity refers to the stability of the variance of one variable at all levels of the other variable (Field, 2009). More generally, homogeneity of variance means that dependent variables have the same levels of variance at all levels of independent variables (Hair *et al.*, 2014). This assumption can be applied when dependent variables are metric regardless of the property of predictor variables (numerical or categorical) (Hair *et al.*, 2014).

When comparing groups, whether this assumption is tenable or not are tested by Levene's test (Field, 2009). In other words the equality of the variances of a single metric variable among groups is identified by Levene's test. If Levene's test indicates statistical significance, it can be assumed that different groups have significantly unequal spread of variances and shows heteroscedasticity (Field, 2009; Hair *et al.*, 2014).

Using SPSS, this research conducted the Levene's test twice according to different types of groups (coastal/ ocean-going shipping and vessel types such as container ship/bulk carrier/tanker/others). Except just one dependent variable of SUS4, the Levene's test for dependent variables of this research showed that all variances of dependent variables between coastal/ocean-going shipping and among different vessel types were significantly equal (i.e. values of significance level are more than 0.05). The significance values of the SUS4 (0.04) for coastal and ocean-going shipping are less than 0.05, which means the variances of the SUS4 between the two groups are different. Appendix 12 shows the outcome of Levene's test for the dependent variables of this research.

7.2 Exploratory factor analysis

In the social sciences, EFA is a widely used and applied method having few absolute guidelines and many options (Osborne and Costello, 2009). EFA examines an initial sample and the results of EFA are used for further purification (Hair *et al.*, 2014).

Based on the discussion about the extraction and rotation methods of EFA in the Appendix 13, the researcher conducted EFA on items with ML as a factor extraction method and the oblique rotation method (Direct Oblimin) respectively.

With regard to ML, the researcher followed Osborne and Costello's (2009) argument that CFA2 (ML) is a preferable method to PCA in that PCA only reduces data and does not distinguish between shared and unique variance and furthermore the method is likely to inflate values of variance explained by the factors. In addition, the conclusions of PCA have the limitation that they cannot be extended to generalisation (Field, 2009). Another reason for the selection of the ML is to maintain the consistency of method with CFA1 tested by AMOS, which uses the method as a default.

With respect to the rotation method, the researcher adopted the oblique rotation because a certain amount of correlation among factors is generally expected in social science (Osborne and Costello, 2009). The non-orthogonal rotation can be justified when perceptual dimensions would be correlated (Hair *et al.*, 2014) and if the factors have correlation among them, measured variables have also correlations with all factors (Graham *et al.*, 2003). In this research, three dimensions presumed to comprise cooperation and five dimensions assumed to compose collaboration would reasonably be correlated and therefore all the factors would also be correlated with all variables. This argument could be identified by the result of the oblique rotation indicating substantive correlations among factors and then it could be concluded that the orthogonal method would be unsuitable (Pedhazur and Schmelkin, 2013).

To sum up, the researcher adopted CFA2 (ML) and oblique rotation (direct oblimin) considering that those methods can produce optimal results from the aspects of generalisability to other samples or the reflection of the nature of population (Osborne and Costello, 2009)

7.2.1 Exploratory factor analysis on three dimensions assumed to comprise cooperation

EFA on initial 16 items presumed to represent cooperation was conducted. The researcher did not detect any cross-loadings (i.e. loadings highly on two or more latent constructs) among items which might provide evidence of a lack of construct validity (Hair *et al.*, 2014). However, the result of EFA found one free-standing indicator variable - MUT2 (shippers are willing to provide their facilities and equipment with our firm). This one item was deleted based on the result.

The sample size (167) is about a 10.4:1 ratio of observations to variables, which falls within the suggestions (from 5:1 to 10:1 ratio) of Hair *et al.* (2014). In EFA with the corresponding 15 items, the results of Bartlett's test (χ^2 = 2868.796, df = 105, p = 0.000) showed that the correlations among the items are significant at the 0.001 level which implies that zero correlations among the items do not exist (Hair *et al.*, 2014). The set of variables met the criterion of sampling adequacy with the KMO measure's value of 0.945. The highly significant results of Bartlett's test and the high value of the KMO MSA indicated that EFA is appropriate with the set of variables.

Considering the sample size (167) of this research, the variables with over 0.45 factor loadings were also selected according to Hair *et al.*'s (2014) recommendation - if the sample size is 150, the factors loadings over 0.45 are significant. In addition, all communalities - the amount of variance in a variable which factors explain - of 15 variables are over 0.5 which is a generally accepted criterion (Hair *et al.*, 2014).

As seen in Table 7-1, based on eigenvalues (over 0.7) and percent of total variance (over 80%) explained by factors, the researcher decided to select three factors representing the 15 variables for further analyses. With regard to eigenvalue, three common factors having initial eigenvalues greater than 0.7 were chosen following the criterion recommended by Jolliffe (1972; 2002). He argued that the criterion of Kaiser (eigenvalue > 1) which is a default value in SPSS is too strict and factors with eigenvalues over 0.7 should be retained. Furthermore, the Kaiser criterion which has been widely employed can lead to over-extraction of factors (Velicer and Jackson, 1990).

The three common factors retained explained 82.5% of total variance of the 15 variables. Variables from MUT1 to MUT8 load highly on factor 1 and factor 2 is characterised by variables FAI1 to FAI4 and finally factor 3 has four distinctive characteristics (from TAR1 to TAR 4).

The items having sufficient factor loadings on the same factor suggest that factor one represents *mutuality*, factor 2 *fairness*, and factor 3 *transparency*.

Table 7-1 Major results of EFA (three sub-constructs of cooperation)

Item	Factor			Communality
	1	2	3	
MUT6	.958			.902
MUT3	.882			.657
MUT7	.829			.759
MUT4	.806			.732
MUT5	.803			.889
MUT8	.762			.822
MUT1	.566			.767
FAI3		-.874		.937
FAI4		-.760		.839
FAI1		-.699		.571
FAI2		-.687		.670
TRA3			.827	.879
TRA2			.819	.644
TRA1			.653	.720
TRA4			.627	.818
Eigenvalues	10.422	1.081	0.872	
% of Variance	69.477	7.205	5.811	
Cumulative %	69.477	76.683	82.494	

Extraction Method: ML.
Rotation Method: Oblimin with Kaiser normalization.

7.2.2 Exploratory factor analysis on five dimensions assumed to comprise collaboration

This research conducted another EFA on initial 24 items. Again, EFA did not find any cross-loadings. However, the result of EFA showed two free-standing items - MUT2 (shippers are willing to provide their facilities and equipment with our firm) and SUS1 (the relationship between shippers and our firm is stable). Considering the EFA result, the researcher decided not to adopt the two items in further analyses for collaboration.

With regard to sample size, about a 7:1 ratio of observations to variables was shown and this ratio corresponds with Hair *et al.*'s (2014) minimum criterion ratio (5:1). With the remaining 22 items, the adequacy of EFA was identified by the KMO (0.944) and Bartlett's test (χ^2 = 4195.77, df = 231, p = 0.000).

As shown in Table 7-2, five common factors with initial eigenvalues higher than 0.7 were identified and they explained 83.3% of total variance. Therefore, 22 items which all have factor loadings over 0.45 were retained for subsequent analyses.

Table 7-2 Major results of EFA (five sub-constructs of collaboration)

Item	Factor					Communality
	1	2	3	4	5	
FAI3	.703					.942
FAI4	.576					.837
FAI1	.523					.577
FAI2	.496					.675
SUS3		.861				.923
SUS4		.774				.879
SUS2		.541				.722
MUT6			-.969			.907
MUT5			-.848			.901
MUT3			-.787			.658
MUT7			-.785			.765
MTU4			-.717			.742
MUT8			-.683			.830
MUT1			-.585			.772
TRA3				-.841		.890
TRA2				-.777		.648
TRA4				-.646		.819
TRA1				-.641		.718
TRU3					.858	.686
TRU2					.834	.873
TRU1					.733	.742
TRU4					.672	.656
Eigenvalues	14.263	1.354	1.10	.877	.725	
% of Variance	64.83	6.154	5.024	3.987	3.296	
Cumulative %	64.83	70.985	76.009	79.996	83.291	

Extraction Method: ML.
Rotation Method: Oblimin with Kaiser Normalization.

In addition, all correlations among factors in Table 7-3 are below 0.7 (Hair *et al.*, 2014) or 0.8 (Field, 2009) which provide one indication of discriminant validity. Furthermore, the correlations among factors in Table 7-3 identified that the adoption of oblique rotation is more reasonable and meaningful than orthogonal rotation (Field, 2009; Pedhazur and Schmelkin, 2013).

Table 7-3 Factor correlation matrix

Factor	1	2	3	4	5
1	1.000	.435	-.597	-.577	.589
2	.435	1.000	-.655	-.543	.639
3	-.597	-.655	1.000	.695	-.690
4	-.577	-.543	.695	1.000	-.535
5	.589	.639	-.690	-.535	1.000

7.3 Measurement model

The specification of CFA1 model implies the procedure of assigning indicator variables *a priori* to the constructs as a proposed theory designates (Bollen, 1989; Steenkamp and Van Trijp, 1991; Hair *et al.*, 2014). In a CFA1 model, all constructs are assumed to be exogenous and all correlated (Hair *et al.*, 2014). The constructs are specified as the independent variables and the items as the dependent variables (Garver and Mentzer, 1999). An error term implies a measurement error for that item (Garver and Mentzer, 1999). The measurement accuracy of constructs is tested for construct validity as well as reliability (Hair *et al.*, 2014).

7.3.1 First order factor measurement model for cooperation

The measurement model for cooperation is depicted in Figure 7-1. The model displays 15 measured indicator variables and three latent variables. Each sub-construct is allowed to correlate with all other sub-constructs. Values to the left of two-headed arrows indicate the correlations among sub-constructs. The 15 measured items are assigned to load on only one sub-construct. The causal paths from sub-constructs to indicators are depicted as one-headed arrows. The values on the one-headed arrows represent standardised regression weights (factor loadings). The values at the upper left of indicators imply squared multiple correlations (i.e. squares of standardised regression weights). The error terms are not allowed to be correlated with each other. To put it another way, there are no cross loadings and covariances between error terms in this model. The measurement model completely follows a confirmatory approach. Therefore, this measurement model can be named as congeneric (Hair *et al.*, 2014).

Given the theory and the result of EFA, *transparency* and *fairness* are represented by four measured items respectively and *mutuality* is described by seven measured items. All measures are hypothesised as reflective in this measurement model. The rule of at least three indicators per construct is observed. All sub-constructs can be identified and this model is over-identified. In other words, the number of items with given information (120) is larger than the number of parameters to be estimated (33) and the corresponding degrees of freedom are 87.

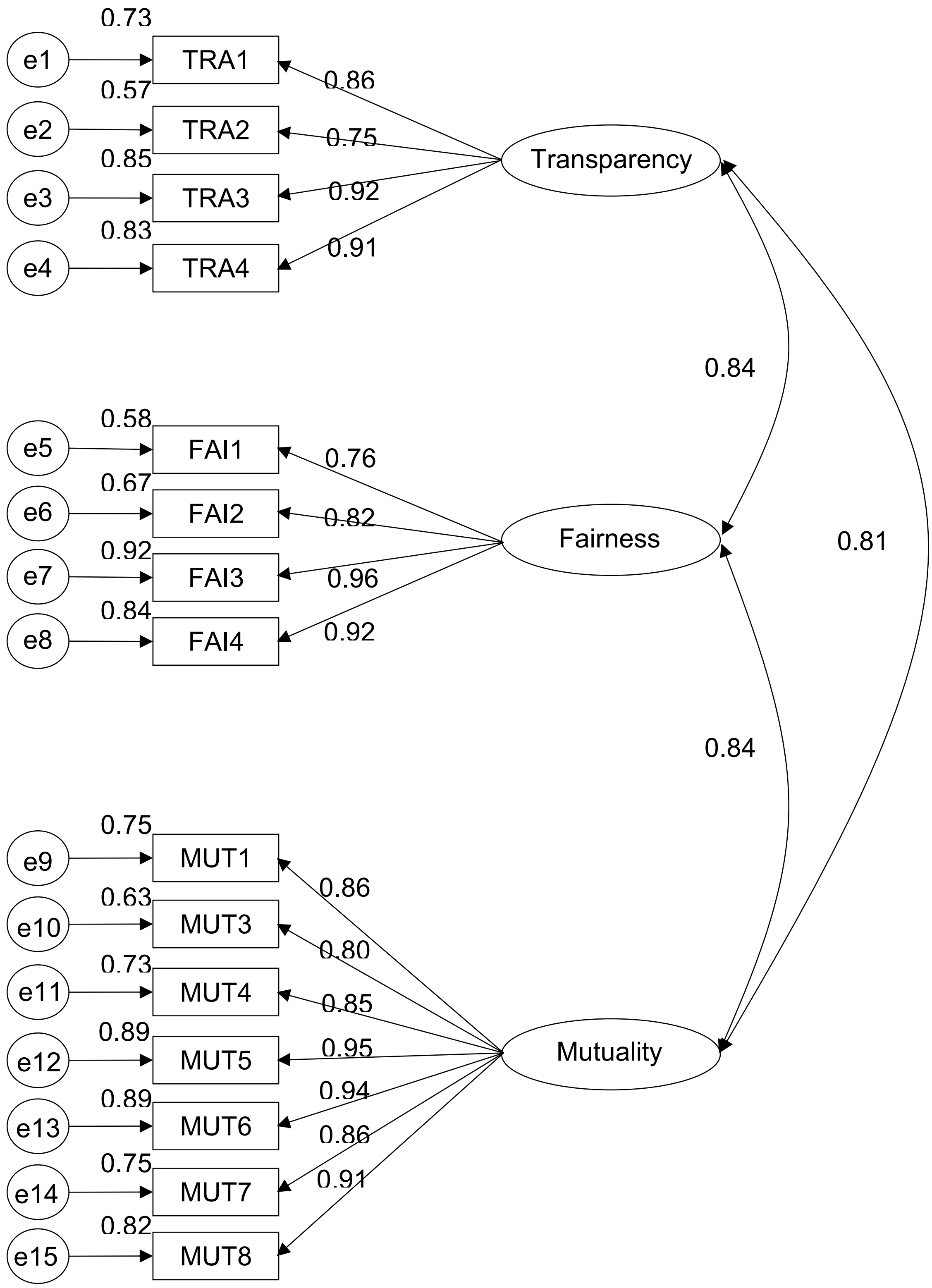
The 167 observations of this study are considered to exceed the required minimum sample size of 100. When a model has five or fewer constructs and more than three items per construct, the model needs at least 100 observations (Hair *et al.*, 2014).

7.3.1.1 Overall model fit

The overall model χ^2 is 273.066 with 87 degrees of freedom. The *p* value associated with this result is 0.000. Therefore, the χ^2 GOF statistic indicates that the observed and estimated covariance does not match. However, the χ^2 GOF statistic has several problems as mentioned in Appendix 14.2 and other model fit indices should also be examined. At least one absolute and one incremental fit index along with χ^2 results should be reported (Hair *et al.*, 2014).

Given 167 of sample size of this model, SRMR (sample with less than 250 observations) is more suitable than RMSEA (larger than 250 observations) (Browne *et al.*, 1993; Holbert and Stephenson, 2002). GFI and normed χ^2 among absolute fit indices are not recommendable (Bollen, 1989; Hu and Bentler, 1999). The CFI and TLI among incremental fit indices are widely used (Hair *et al.*, 2014). Therefore, SRMR as absolute fit index and TLI and CFI as incremental fit indices are chosen. The value for SRMR is 0.0395 which is below even the conservative threshold value of 0.05 (Byrne, 2010). TLI had a value of 0.922 which exceeds the critical value of greater than 0.90 (Hulland *et al.*, 1996). CFI with a value of 0.935 also satisfied the threshold of over 0.90 (Baumgartner and Homburg, 1996). The values of SRMR, TLI and CFI indicate that the measurement model of cooperation provides a reasonably good fit.

Figure 7-1 Measurement model of cooperation



Chi-square = 273.066, Degrees of freedom = 87, SRMR=0.0395, TLI=0.922, CFI=0.935

7.3.1.2 Convergent validity

As summarised in Table A14-3 in Appendix 14, convergent validity for the measurement model is examined by standardised factor loading, AVE and reliability as shown in Table 7-4 as well as by model fit. The AMOS program provides several estimates about (un) standardised regression weight, critical ratio and *p* value, standard error, and squared multiple correlations (R^2).

All standardised factor loadings (standardised regression weights) exceed the threshold of 0.7 (Garver and Mentzer, 1999; Hair et al., 2014). Therefore, all the corresponding squared multiple correlations (squared factor loadings) are over the critical value of 0.5 (Garver and Mentzer, 1999; Hair et al., 2014). The lowest factor loading is 0.752 which links transparency to item TRA2 and its squared factor loading is 0.566.

The values and statistical significance of critical ratio imply that all factor loadings are reasonable and statistically significant at $p < 0.001$. The AVE estimates range from 0.745 for transparency to 0.779 for mutuality. All the estimates exceed the threshold of 0.5 (50%) (Garver and Mentzer, 1999; Hair *et al.*, 2014). CRs show the scope from 0.921 for transparency to 0.961 for mutuality. These values also satisfy the criterion of adequate reliability of 0.7 (Hair *et al.*, 2014). In all cases Cronbach's α exceeds 0.7 (Garver and Mentzer, 1999).

Given the values related to factor loadings, AVEs, CRs as well as a good model fit indices, the convergent validity of the measurement model for cooperation is strongly supported.

Table 7-4 CFA1 results for sub-constructs of cooperation

Sub-construct	Items	Standardised regression weight (> 0.7)	Critical ratio (t-value)	Squared multiple correlations (> 0.5)	Standard error	CR (ρ_c) (> 0.7)	AVE (> 0.5)	Cronbach's alpha (α) (> 0.7)
Transparency	TRA1	0.857	16.378***	0.734	0.055	0.921	0.745	0.920
	TRA2	0.752	12.607***	0.566	0.063			
	TRA3	0.921	19.559***	0.849	0.049			
	TRA4	0.913	-[a]	0.834	-[a]			
Fairness	FAI1	0.759	13.031***	0.575	0.057	0.923	0.752	0.925
	FAI2	0.818	15.136***	0.669	0.056			
	FAI3	0.962	23.062***	0.925	0.047			
	FAI4	0.916	-[a]	0.84	-[a]			
Mutuality	MUT1	0.864	16.969***	0.746	0.054	0.961	0.779	0.960
	MUT3	0.795	14.18***	0.632	0.067			
	MUT4	0.852	16.422***	0.726	0.056			
	MUT5	0.946	21.795***	0.894	0.046			
	MUT6	0.939	21.323***	0.882	0.047			
	MUT7	0.864	16.999***	0.747	0.053			
	MUT8	0.907	-[a]	0.823	-[a]			
Chi-square = 273.066, Degrees of freedom = 87, TLI = 0.922, CFI = 0.935, SRMR = 0.0395								

Note. a: not estimated because loading was fixed at 1.0, *** : $p < 0.001$

7.3.1.3 Discriminant validity

To establish discriminant validity, the comparisons between square roots of AVE estimates for each factor and values of inter-factor correlation associated with the factors are made (Hair *et al.*, 2014). As seen in Table 7-5, correlations range from 0.81 for between *transparency* and *mutuality* to 0.842 for between *fairness* and *mutuality*. All correlations are significant at $p < 0.001$.

Table 7-5 Correlations between sub-constructs

	Standardised covariance estimate[a]	Standard error	Critical ratio	*p*
Transparency ⇔ Fairness	0.838	0.231	7.563	***
Transparency ⇔ Mutuality	0.81	0.225	7.413	***
Fairness ⇔ Mutuality	0.842	0.237	7.594	***

Note. a: Correlation estimates, *** significant at the 0.001 significance level

All square roots of AVE estimates from Table 7-6 are larger than the corresponding three pair-wise correlation estimates among sub-constructs. Table 7-6 supports that the measurement model for cooperation has no problems with discriminant validity. In addition, discriminant validity is also supported by the congeneric property of this model. This is because this model did not include any cross loadings between indicators (Hair *et al.*, 2014). Furthermore, the three pair-wise correlations among the first order factors justify the specification of the second order factor (Garver and Mentzer, 1999).

Table 7-6 Discriminant validity of the sub-constructs of cooperation

	Transparency	*Fairness*	*Mutuality*
Transparency	0.863[a]		
Fairness	0.838[b]	0.867[a]	
Mutuality	0.810[b]	0.842[b]	0.882[a]

Note. a: square root of the AVE for each sub-construct
b: correlations for each pair of sub-construct

7.3.1.4 Unidimensionality of sub-constructs and diagnostics for the measurement model

The assumption of unidimensionality is supported by the significant standardised regression weights exceeding 0.7, good model fit and relatively low values of standardised residuals and MIs (Garver and Mentzer, 1999). Standardised residuals and MIs also provide information about model misspecification (Byrne, 2010; Hair *et al.*, 2014).

Table 7-4 above shows all the standardised regression weights exceed 0.7. The first order factor measurement model for cooperation demonstrates good fits (SRMR=0.0395, TLI=0.922, CFI=0.935).

Moreover, all standardised residuals are below the critical value of $|2.58|$ (Jöreskog and Sörbom, 1993; Medsker *et al.*, 1994) or $|4.0|$ (Hair *et al.*, 2014). The largest value is 1.839 of the standardised residual covariance between MUT3 and MUT4. This result provides an evidence of no cross loadings (Steenkamp and Van Trijp, 1991).

In terms of MIs, three pair-wise items that could have measurement error covariances if specified are detected: 55.45 between e10 and e11, 25.14 between e7 and e8, 13.57 between e2 and e3. The values of over 7.88 are considered to be large (Jöreskog and Bollen, 1993). Especially the pair of e10 and e11 stands apart in that the MI value is substantially larger than others.

In this case, the examination of whether the contents of the items have a high degree of overlap or not can be a good criterion concerning whether the error covariance should be estimated or not (Byrne, 2010). The error term e10 is related to the item MUT4 (shippers are willing to assist our firm in overcoming the difficulties when our firm is faced with any difficulties) and the error term e11 is associated with the item MUT3 (shippers are willing to provide financial support such as guarantee of a bank loan required for procurement of vessels for our firm). MUT3 asked about financial support of shippers whereas MUT4 asked about general assistance of shippers. Given that the financial difficulty among managerial adversities can be the most problematic to shipping companies, the two items can be considered to have some degrees of overlap. However, the substantive rationale for the estimation of the covariance between the error terms is not considered to be sufficient. The other two pair-wise error terms (e7-e8 and e2-e3) do not show any overlap among corresponding item contents.

Furthermore, the three pair-wise error terms do not represent any problematic values in terms of standardised residual covariances. It should also be considered that the estimation of correlations among the error terms without theoretical and methodological justifications is not desirable in that CFA1 has a confirmatory attribute and such estimations can cause ambiguousness of reliability (Bollen, 1989). Hence, any error covariances are not introduced in this model and a congeneric measurement model is maintained throughout this empirical analysis.

To sum up, the unidimensionality can be properly supported by the evidence which the standardised regression weights, the model fit and the values of standardised residuals provide.

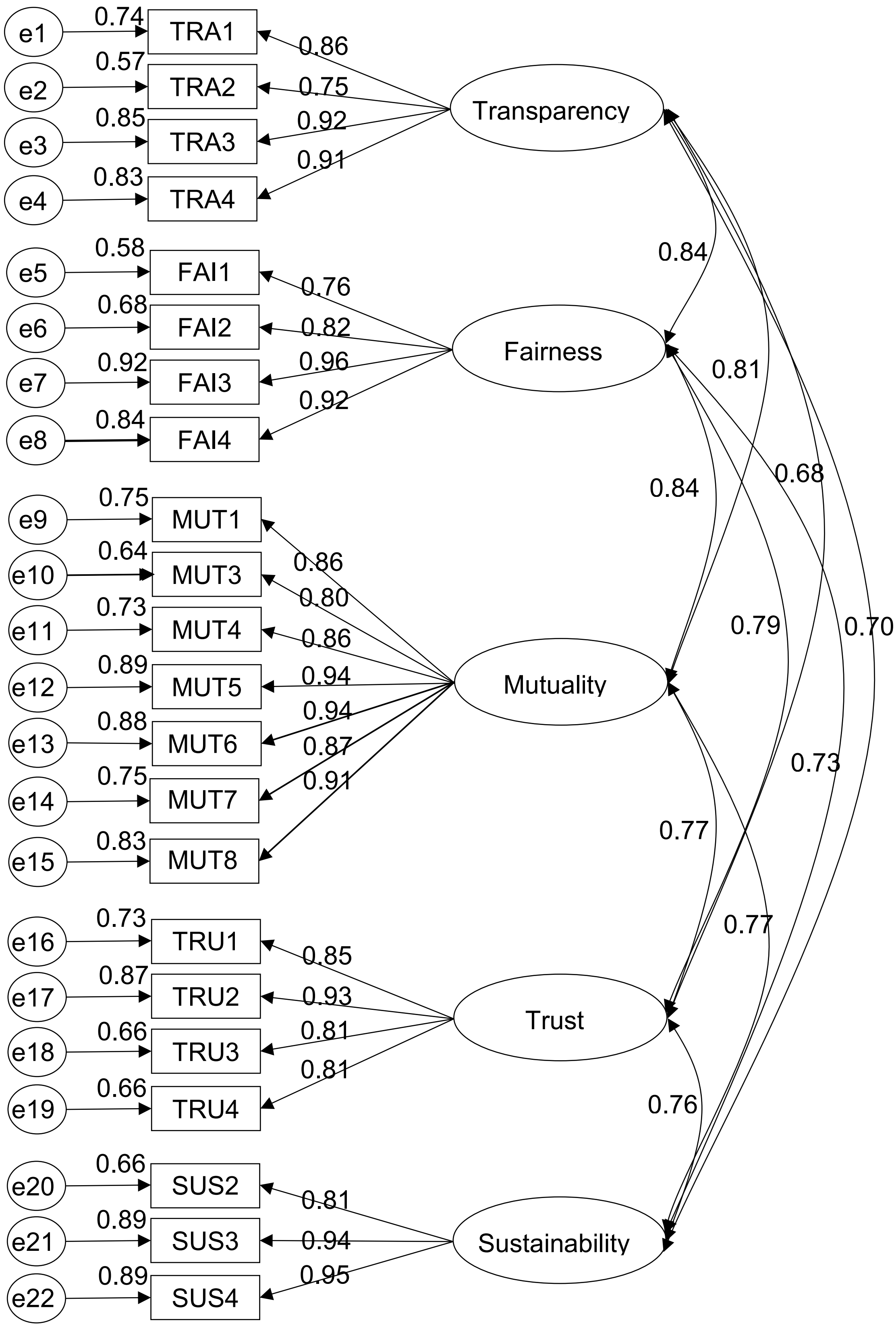
7.3.2 First order factor measurement model for collaboration

Figure 7-2 depicts the measurement model for collaboration. The model displays 22 measured indicator variables and five latent variables. Each sub-construct is correlated with each other. The 22 measured items are assigned to load on the corresponding one sub-construct according to theory. For CFA1 test, such congeneric measurement model as the measurement model for cooperation is also utilised. Unlike the measurement model for cooperation, additional two sub-constructs such as *trust* and *sustainability* are included in the measurement model for collaboration. *Trust* and *sustainability* are respectively represented by four measured items and by three. The rule of at least three indicators per construct is continuously observed. This model is also over-identified. The number of parameters to be estimated (54) is outnumbered by the amount of given information (253). The degrees of freedom are 199. The minimum sample size (100) is also satisfied (Hair *et al.*, 2014).

7.3.2.1 Overall model fit

The overall model χ^2 indicates 507.879 with 199 degrees of freedom. The *p* value of 0.000 demonstrates that the observed and estimated covariance does not match. However, other model fit indices show good fit. As discussed in overall model fit in the measurement model for cooperation, SRMR, TLI and CFI are selected to report. The value for SRMR of 0.0426 satisfies the critical value of below 0.05. The values for TLI and CFI, 0.914 and 0.926 respectively, exceed the threshold of 0.90. Through those fit indices, it is verified that the measurement model for collaboration provides a reasonably good fit.

Figure 7-2 Measurement model for collaboration



Chi-square = 507.879, df = 199, SRMR = 0.0426, TLI = 0.914, CFI = 0.926

7.3.2.2 Convergent validity

Table 7-7 describes the estimates associated with convergent validity. All standardised factor loadings exceed the critical value of 0.7. All the corresponding squared multiple correlations also exceed the threshold of 0.5. Item TRA2 has the lowest factor loading of 0.754 and its squared multiple correlation is 0.568. All factor loadings are identified to be reasonable and statistically significant at the 0.001 significance level. All AVE estimates with the range from 0.746 to 0.814 also exceed the critical value of 0.5. CRs from 0.914 to 0.961 and Cronbach's αs from 0.914 to 0.960 also satisfy the minimum criterion of 0.7. Good fit indices, the estimates related to factor loadings, AVEs, and CRs strongly support the convergent validity of the measurement model for collaboration.

Table 7-7 CFA1 results for the sub-constructs of collaboration

Construct	Items	Standardised regression weight	Critical ratio (*t*-value)	Squared multiple correlations	Standard error	CR (ρ_c)	AVE	Cronbach's alpha (α)
Transparency	TRA1	0.857	16.398***	0.735	0.055	0.921	0.746	0.920
	TRA2	0.754	12.651***	0.568	0.063			
	TRA3	0.920	19.493***	0.847	0.050			
	TRA4	0.913	-[a]	0.833	-[a]			
Fairness	FAI1	0.761	13.121***	0.578	0.057	0.924	0.754	0.925
	FAI2	0.822	15.331***	0.675	0.055			
	FAI3	0.958	23.025***	0.917	0.047			
	FAI4	0.918	-[a]	0.843	-[a]			
Mutuality	MUT1	0.864	17.125***	0.747	0.053	0.961	0.779	0.960
	MUT3	0.798	14.346***	0.636	0.066			
	MUT4	0.855	16.704***	0.732	0.056			
	MUT5	0.942	21.785***	0.887	0.046			
	MUT6	0.937	21.429***	0.878	0.047			
	MUT7	0.866	17.183***	0.749	0.052			
	MUT8	0.910	-[a]	0.829	-[a]			
Trust	TRU1	0.852	13.023***	0.725	0.079	0.914	0.780	0.914
	TRU2	0.932	14.824***	0.868	0.077			
	TRU3	0.812	12.146***	0.659	0.079			
	TRU4	0.812	-[a]	0.659	-[a]			
Sustainability	SUS2	0.814	15.536***	0.662	0.053	0.929	0.814	0.924
	SUS3	0.941	23.005***	0.885	0.040			
	SUS4	0.945	-[a]	0.893	-[a]			
Chi-square = 507.879, Degrees of freedom = 199, SRMR = 0.0426, TLI = 0.914, CFI = 0.926								

Note. a: not estimated because loading was fixed at 1.0, *** : $p < 0.001$

7.3.2.3 Discriminant validity

As shown in Table 7-8, all correlations among sub-constructs supposed to represent collaboration are significant at the 0.001 level. All values of square roots of AVEs exceed the corresponding ten pair-wise values of correlations among sub-constructs. Discriminant validity is supported by the result. In addition, the specification of the second order factor can be justified by that the values of ten pair-wise correlations among the first order factors exceed 0.7 or are nearly the same as 0.7 (Garver and Mentzer, 1999).

Table 7-8 Discriminant validity of the sub-constructs of collaboration

	Transparency	*Fairness*	*Mutuality*	*Trust*	*Sustainability*
Transparency	0.864[a]				
Fairness	0.839[b***]	0.868[a]			
Mutuality	0.810[b***]	0.842[b***]	0.883[a]		
Trust	0.681[b***]	0.792[b***]	0.774[b***]	0.853[a]	
Sustainability	0.697[b***]	0.762[b***]	0.771[b***]	0.762[b***]	0.902[a]

Note: a: square root of the AVE for each sub-construct
b: correlations for each pair of sub-construct of collaboration
***: significant at the 0.001 significance level

7.3.2.4 Unidimensionality of sub-constructs

As shown in Table 7-7 above, all the standardised regression weights exceed 0.7 and the conditions of good model fit are satisfied (SRMR=0.0426, TLI=0.914, CFI=0.926). In addition, all standardised residuals are within the recommended values of $|2.58|$ (Jöreskog and Sörbom, 1993; Medsker *et al.*, 1994) or $|4.0|$ (Hair *et al.*, 2014). The standardised residual covariance between MUT3 and

MUT4 shows the largest value of 1.781. Therefore, this measurement model can be considered to have sufficient evidence for unidimensionality.

7.3.3 Validation of second order constructs

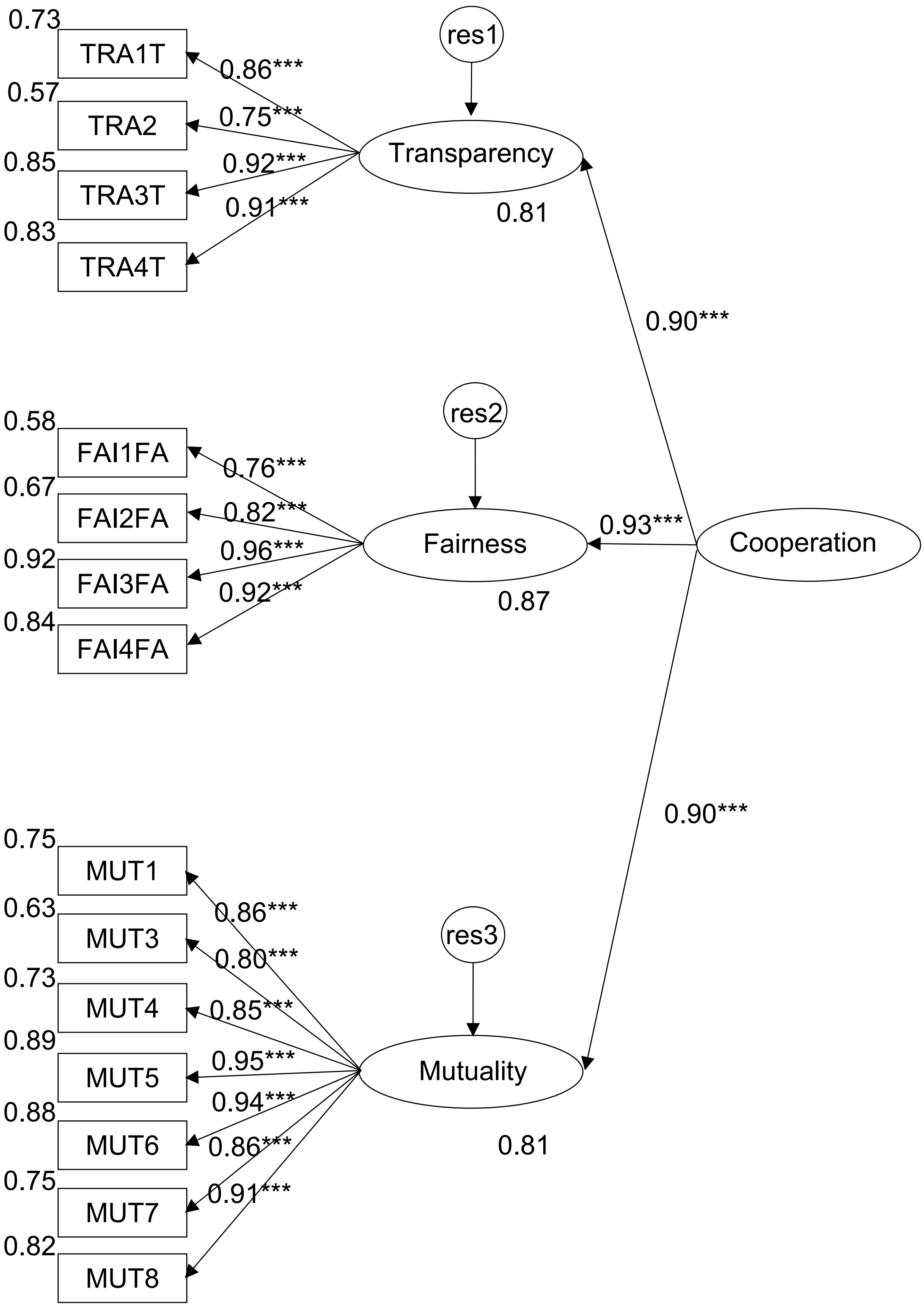
The Chi-square (χ^2) test can be adapted to the comparison between models as well as the GOF assessment (Hair *et al.*, 2014). The comparison of differences between the two Chi-square (χ^2) tests is a standard approach to model comparison (Bentler and Chou, 1987). A large difference of Chi-square (χ^2) values between two models would support the difference between the two models (Hair *et al.*, 2014). The covariation between the first order factors can be explained by the second order factor in a parsimonious way. However, the second order factor cannot completely explain the variation shared by the first order factors (Marsh and Hocevar, 1985; Segars and Grover, 1998). Therefore, the fit indices of the second order factor model are always poorer than those of the corresponding first order factors model (Marsh and Hocevar, 1985; Segars and Grover, 1998). In this sense, the basic first order factor model suggests a target fit for the second order factor model (Marsh and Hocevar, 1985).

The target coefficient (*T*) was developed by Marsh and Hocevar (1985) to assess the efficiency of a second order factor model. The target coefficient can also be utilised to compare models (Doll *et al.*, 1995). The target coefficient is calculated by the ratio of the Chi square of the first order model to that of the second order model (Marsh and Hocevar, 1985). The target implies the percent of variation in the first order factors that the second order construct explains (Doll *et al.*, 1995). The target coefficient with a value of 0.8 to 1.0 demonstrates the existence of a second order construct (Cao and Zhang, 2010). The target coefficient of 1 implies that the relations between the first order factors could be completely explained in terms of the second order factor (Marsh and Hocevar, 1985). The coefficient become greater as the number of parameters estimated in the second order model increases (Marsh and Hocevar, 1985). To identify the second order factor model, at least three corresponding first order factors are needed. If the first order factors were two or one, the problem of identification at the second order factor model would happen (Kline, 2011).

7.3.3.1 Second order factor measurement model for cooperation

Figure 7-3 depicts the second order factor model for *cooperation*. *Cooperation* is measured indirectly by the indicators of the first order factors. Single headed arrows from the second order factor (cooperation) to each of the first order factors (*transparency, fairness* and *mutuality*) demonstrate the second order factor loadings. The first order factors are loaded on the second order factor and act as both independent and dependent variables. The standardised factor loadings of the measurement items on respective first order factors range from 0.75 to 0.96 and are all significant at the level of 0.001. The standardised factor loadings of the first order factors on the second order factor range from 0.90 to 0.93. The paths are strong and statistically significant at the 0.001 level. The second order construct explains 81%, 87% and 81% respectively in variation of the first order factors (*transparency, fairness*, and *mutuality*). Residual error terms (res1 to res3) are associated with the first order factors.

Figure 7-3 Second order measurement model for cooperation



Chi-square = 273.066, df = 87, SRMR = 0.0395, TLI = 0.922, CFI = 0.935

*** Significant at the 0.001 level

Table 7-9 shows fit indices and target coefficient between the first order and second order models. The fit indices indicate that the model fits the data quite well. The specification of the second order factor can be justified by the statistically significant estimates and good model fit. The calculated target coefficient between the first and the second order factor model is 1. The Chi squares of the first order and the second order models are exactly the same. This implies that the second order factor sufficiently captures the relationship among first order factors. This result provides good evidence of the existence of a higher order construct, i.e. *cooperation*.

The result also implies that the second order structure is efficient (Stewart and Segars, 2002). As shown in Table 7-9, the critical values of fit indices are fully satisfied in the second order factor model. In addition, fit statistics between two models are also identical. This can be understood by the fact that the second order model is a special case of the first order model and the second order model of *cooperation* is a just-identified model (Byrne, 2010). The second order construct, *cooperation* will be utilised in a structural model (7.4) to test hypothesis 1 (H_1: Cooperation is positively related to trust).

Table 7-9 Fit indices and *T* coefficient between the first order and the second order models for cooperation

Construct	model	χ^2	df	SRMR	TLI	CFI	*T* coefficient
Cooperation	First order	273.066	87	0.0395	0.922	0.935	1
	Second order	273.066	87	0.0395	0.922	0.935	

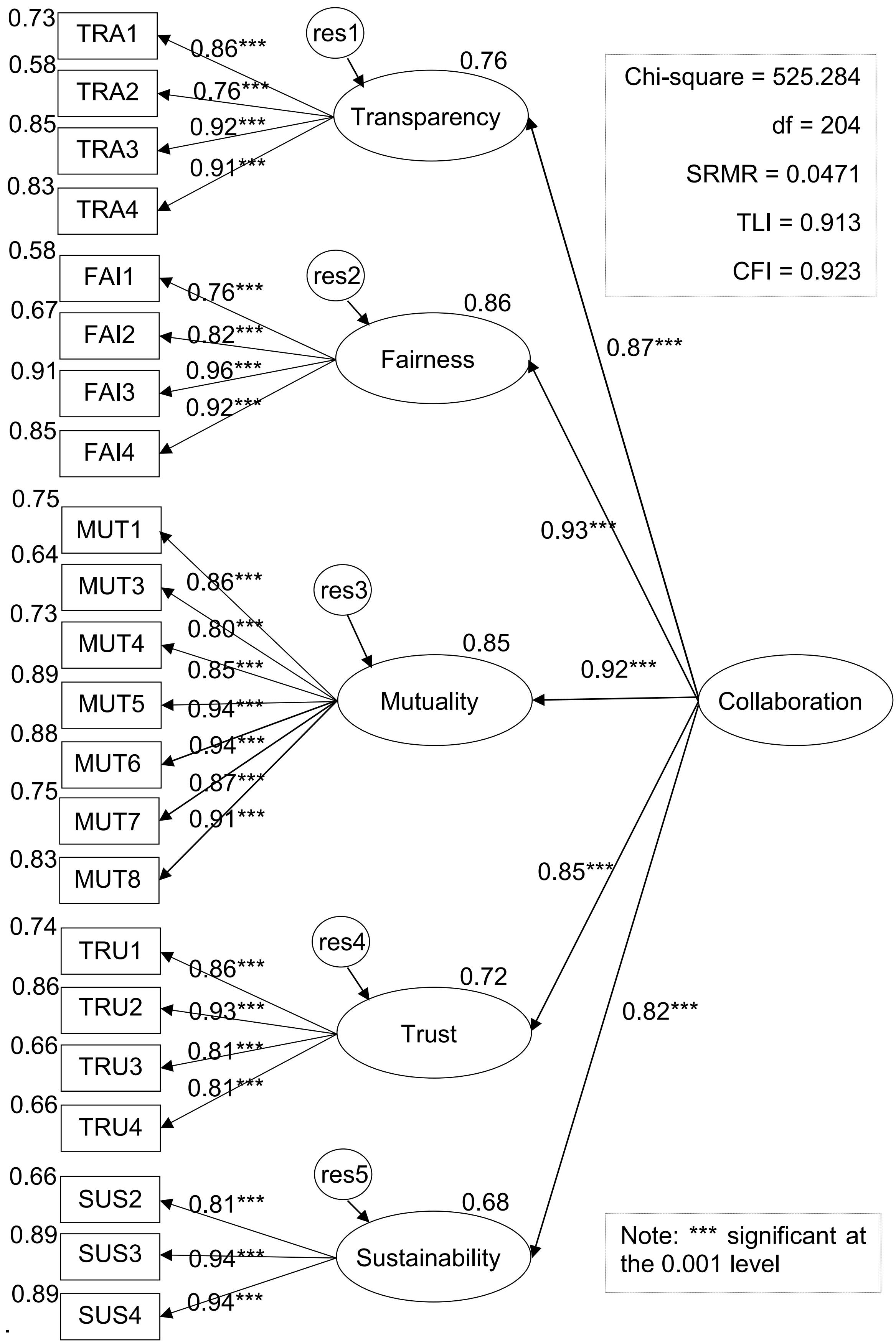
7.3.3.2 Second order factor measurement model for collaboration

The second order factor model for collaboration is depicted in Figure 7-4. The estimates from the second order factor to the first order factors show a strong and statistically significant relationship at the 0.001 level. The 76% (*transparency*), 86% (*fairness*), 85% (*mutuality*), 72% (*trust*), and 68% (*sustainability*) of variation of first order factors are respectively explained by the second order factor. Table 7-10 describes fit indices and target coefficient between the first order and second order models for *collaboration*. The model fit indices satisfy the recommended thresholds for each fit. The *T* coefficient of 0.967 indicates that the second order construct exists and the second factor model is efficient. The first order factors are sufficiently explained by the second order construct, i.e. *collaboration*.

Table 7-10 Fit indices and *T* coefficient between the first order and the second order models for collaboration

Construct	model	χ^2	df	SRMR	TLI	CFI	*T* coefficient
Collaboration	First order	507.879	199	0.0426	0.914	0.926	0.967
	Second order	525.284	204	0.0471	0.913	0.923	

Figure 7-4 Second order measurement model for collaboration



7.3.4 Supplementary analysis: Common method bias

Common method variance implies "the extent of the erroneous relationship that is measured between two (or more) variables that are measured in the same way (e.g., at the same time, on the same questionnaire, using the same rating scales)" (Tharenou *et al.*, 2007, p.62). Common method variance is a measurement variance attributable to an instrument not to constructs (Campbell and Fiske, 1959; Spector, 1987; Podsakoff *et al.*, 2003). Common method variance is widely considered to inflate or overestimate the associations among variables measured with the same method (Williams and Brown, 1994; Spector, 2006) and to create a false internal consistency (Chang *et al.*, 2010). Because method biases can be one of the main reasons for measurement error, they can be problematic (Podsakoff *et al.*, 2003).

There are four general causes which raise common method variance (Podsakoff *et al.*, 2003): common rater effects such as leniency biases, item characteristic effects such as item social desirability, item context effects such as context-induced mood and scale length, measurement context effects such as measuring variables at the same location/time and with the same medium.

The following four approaches to avoid or detect common method bias are suggested (Podsakoff *et al.*, 2003): using other sources of information for constructing variables; mixing the order of questions or utilising different types of scales; making use of intricate specifications of regression models; adopting statistical remedies such as a *post hoc* Harman one-FA or other statistical methods to partial out the common factors or to control the factors.

The first and second approaches can be named as *ex ante* methods included in the research design stage and the third and last approaches are *ex post* methods implemented after research was already conducted (Chang *et al.*, 2010).

Among statistical methods for addressing the common method variance, the unmeasured latent method factor technique is utilised in this study. The unmeasured latent method factor technique is the oldest latent variable control method (Podsakoff *et al.*, 2012).

Specifically, Widaman's (1985) comparison of three models can be utilised to identify the possibility of common method bias as well as convergent and discriminant validity (Iverson and Maguire, 2000). The three models imply a null model, one factor model and a second order model (Iverson and Maguire, 2000; Min and Mentzer, 2004). In a null model, all items function as unique factors and in one factor model, individual items are only loaded on single unique first order factor. In a second order model (a hypothesised model), individual items are loaded on each appropriate first order factors which are allowed to load on the second order factor (Min and Mentzer, 2004). Significantly, better fit of a second order model than those of null and one factor models represents the minimised probability of the existence of common method bias (Iverson and Maguire, 2000).

Table 7-11 compares the values of Chi-squares and each fit of the three models comprised of 15 items for cooperation and 22 items for collaboration. Significant $\Delta\chi^2$ statistics (regarding collaboration, $\Delta\chi^2$ (22) = 3184.7, $p < 0.001$ between null and one factor models, $\Delta\chi^2$ (5) = 702.9, $p < 0.001$ between one factor and second order factor models) and the improvement of model fit indices from null model to second order factor model indicate that the possibility of common method bias is minimised (Iverson and Maguire, 2000) and not a great concern.

For reference, the significance difference between M0 and M1 model identifies once again the convergent validity and the significant difference between M1 and M2 model supports the discriminant validity (Min and Mentzer, 2004).

Table 7-11 Comparison of three models' fits

		Null (M0)	One factor (M1)	Second order factor (M2)	M0-M1	M1-M2
Cooperation	χ^2	2973.2	633.0	273.0	2340.2***	360.0***
	DF	105	90	87	15	3
	SRMR	0.6335	0.0679	0.0395	SI	SI
	TLI	0	0.779	0.922	SI	SI
	CFI	0	0.811	0.935	SI	SI
Collaboration	χ^2	4412.8	1228.1	525.2	3184.7***	702.9***
	DF	231	209	204	22	5
	SRMR	0.6077	0.0695	0.0471	SI	SI
	TLI	0	0.731	0.913	SI	SI
	CFI	0	0.756	0.923	SI	SI

Note. ***: significant at the 0.001 significance level, SI: Significantly Improved

7.4 Structural model

7.4.1 Structural model for collaboration with first order factors

Through structural modelling, the consistency of the structural relationships among five sub-constructs comprising collaboration with theoretical expectations is tested (Hair *et al.*, 2014).

Figure 7-5 illustrates the structural relationships among sub-constructs established in 3.3 as well as the measurement relationships of indicators to sub-constructs. *Transparency, fairness* and *mutuality* are specified as exogenous constructs and *trust* and *sustainability* as endogenous constructs. Paths from exogenous to endogenous constructs are drawn based on the hypotheses. The following structural relationships were proposed:

> *H_1. There is a positive relationship between cooperation and trust.*
>
> *H_2. There is a positive relationship between transparency and trust.*
>
> *H_3. There is a positive relationship between fairness and trust.*
>
> *H_4. There is a positive relationship between mutuality and trust.*
>
> *H_5. There is a positive relationship between trust and sustainability.*

The hypotheses H_2, H_3, H_4 and H_5 are specified with single headed arrows linking sub-constructs. H_1 is tested in another structural model involving the second order factor, *cooperation*. Three curved and two headed arrows represent the correlational relationships among three exogenous constructs.

The establishment of correlations among the exogenous constructs can make the estimates for dependent relationships among constructs more reliable (Hair *et al.*, 2014). Measurement error terms are omitted for simplicity. The parts of endogenous constructs not explained by exogenous constructs are represented by res1 and res2. All other relationships which this structural model does not specify are assumed to be constrained to zero. A structural model should be supported by good model fit and statistically significant parameter estimates including the evaluation of the predicted direction (Hair *et al.*, 2014).

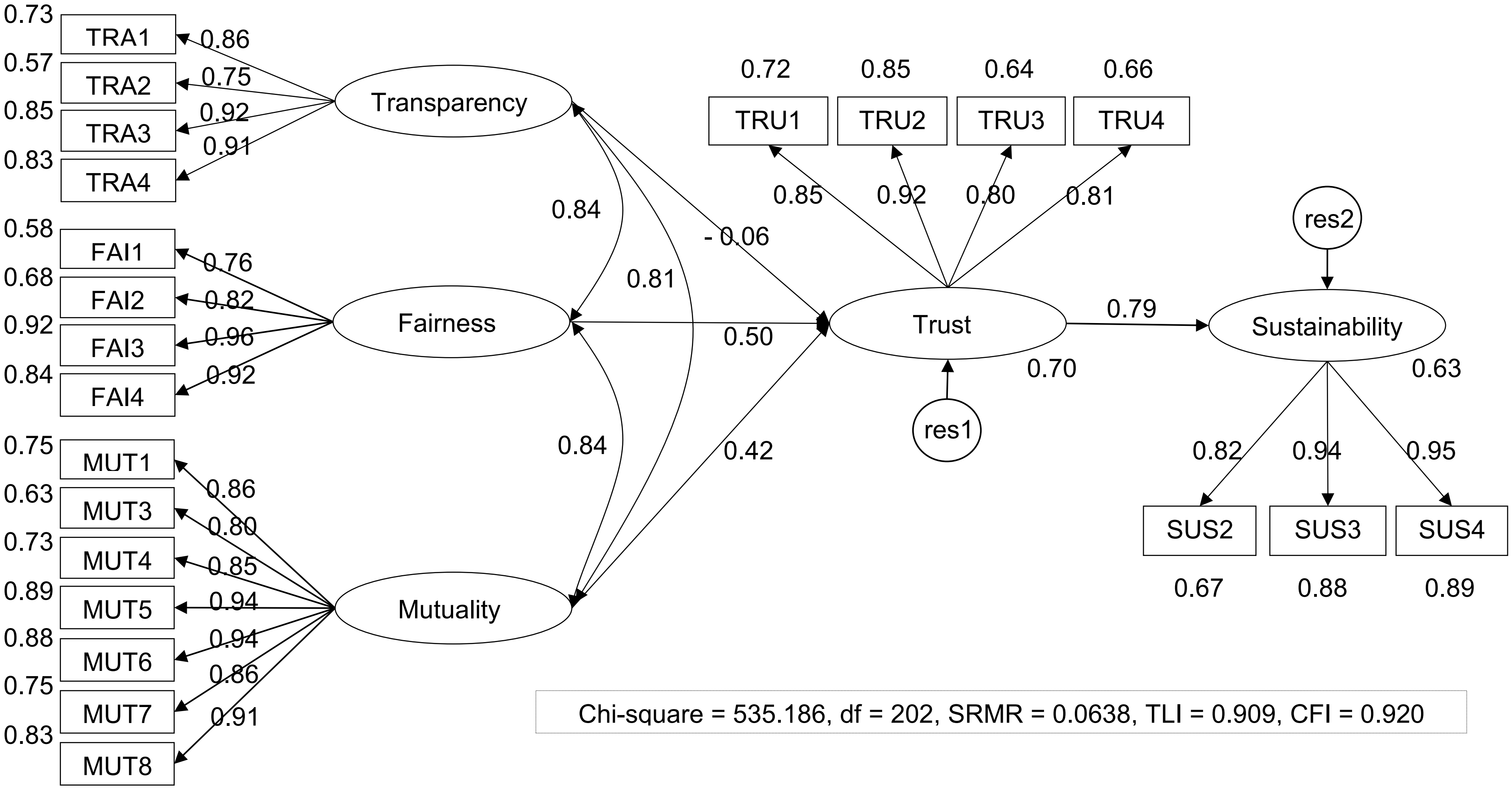
All constructs are correlated with one another in a CFA1 model whereas some relationships between constructs are presumed to be zero in a structural model. This is why a χ^2 GOF statistic for a structural model has almost a larger value than that of a CFA1 model (Hair *et al.*, 2014).

As seen in Table 7-12, the structural model provides evidence of good model fit except SRMR. The SRMR of 0.0638 falls short of the recommended criterion of less than 0.05 (Byrne, 2010). However, values as high as 0.08 are considered to be acceptable (Hu and Bentler, 1999). Therefore, this structural model can be evaluated to have acceptable good model fit.

Table 7-12 Comparison of GOF measures between structural and CFA models

Model	χ^2	df	SRMR	TLI	CFI
CFA1	507.879	199	0.0426	0.914	0.926
Structural	535.186	202	0.0638	0.909	0.920

Figure 7-5 Structural model of the first order factors for collaboration



The standardised structural path coefficients are presented in Table 7-13. Although they are not described in Table 7-13, the factor loadings of indicators and three correlational relationships among sub-constructs are all significant at the 0.001 level and have almost the same values as those of the CFA1 model for collaboration.

Table 7-13 demonstrates that three of the four structural path estimates are significant and in the expected direction. Hypotheses H_3, H_4, and H_5 are supported by the significant and positive path estimates. However, the dependence relationship of *trust* from *transparency* is identified as not significant. Therefore, the corresponding hypothesis H_2 is rejected.

Overall, given that three of the four paths correspond to the hypotheses, this structural model can be supported with a caveat that one path is not supported (Hair *et al.*, 2014). The sizes of path coefficients represent that *fairness* has a greater impact on *trust* than *mutuality* has. Moreover, *trust* has a substantial effect on *sustainability*. On the whole, these results also support nomological or predictive validity of this structural model.

Table 7-13 Structural parameter estimates of first order factors of collaboration

Structural Relationship	Standardised regression weight	*t* value	Accept/Reject
Transparency → Trust (H_2)	-0.057	-0.521	Reject
Fairness →Trust (H_3)	0.501	4.047***	Accept
Mutuality →Trust (H_4)	0.424	3.868***	Accept
Trust →Sustainability (H_5)	0.793	10.987***	Accept
Overall GOF indices χ^2 = 535.186 (df = 202), SRMR = 0.0638, TLI = 0.909, CFI = 0.920			

Note: *** significant at the 0.001 significance level

7.4.2 Structural model for collaboration with second order factor

The second order construct, i.e. *cooperation*, is newly imposed to test the hypothesis H_1 (cooperation is positively related to trust). Figure 7-6 shows that the second order construct, *cooperation* plays a role of exogenous construct in the established structural model.

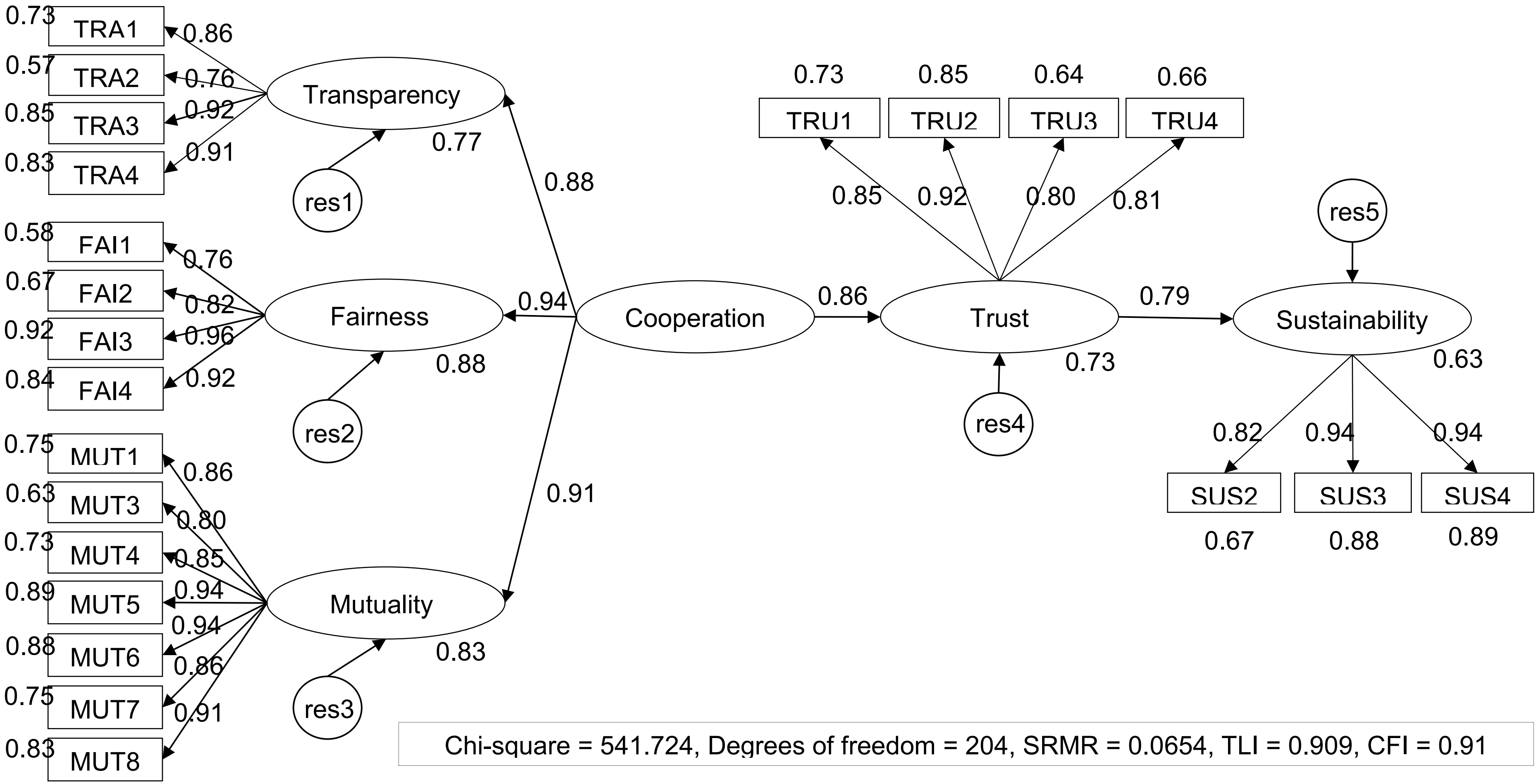
In terms of GOF statistics, as described in the row of structural second order in Table 7-14, TLI and CFI exceed the threshold of 0.9 (Baumgartner and Homburg, 1996) whereas SRMR shows an acceptable level of 0.0654 (Hu and Bentler, 1999). Therefore, this model can also be considered to be acceptable and good. Table 7-14 also indicates that as the number of parameters to be estimated is smaller, degrees of freedom and χ^2 become larger and model fit indices become a little worse. All regression weights are significant at the 0.001 level.

Table 7-14 Comparison of GOF measures between two structural and CFA models

Model		χ^2	df	SRMR	TLI	CFI
CFA		507.879	199	0.0426	0.914	0.926
Structural	first order	535.186	202	0.0638	0.909	0.920
	second order	541.724	204	0.0654	0.909	0.919

As seen in Figure 7-6, two significant path coefficients show the direction as expected. The hypothesis H_1 is supported by a very high path coefficient of 0.86 (t value 10.223). The hypothesis H_5 is again supported by the same value of coefficient (0.79) as that of the structural model of first order factor of collaboration.

Figure 7-6 Structural model for collaboration including cooperation



7.5 Computation and comparison of cooperative and collaborative spirit indices

There are three methods for replacing the original set of variables for further analyses such as using single surrogate variable, factor scores and summated scales. Recently most research prefers the summated scales and the factor scores to a surrogate variable and the two composite measures (the summated scales and the factor scores) do not show any essential difference from an empirical perspective. Well-constructed, valid and reliable summated scales are probably a better choice when generalisability is desirable. As EFA identifies factors of variables and provides efficient data reduction method, EFA has recently been utilised even more as the foundation for the development of summated scale. Through the EFA, the items with high loadings on each factor are weight averaged to calculate each factor's index. Taking the average of the items is the most common approach because of the ease of calculation and use in subsequent analyses (Hair *et al.*, 2014, pp.122-126).

In this research summated scales for factors one, two and three (*cooperation*) and factors one to five (*collaboration*) substituted for the original 15 variables and 22 variables respectively for further analyses. In the case of *cooperation*, three-factor solution indicates that three summated scales could be developed and as for *collaboration*, five-factor solution implies that five summated scales could be possible respectively.

With regard to index development as discussed in 2.3.3, the sequence of steps suggested by Nardo and Saisana (2008) and OECD (2008) is followed. Based on the theoretical framework, the components of CCSIs were carefully selected through related theories, literature review and interviews with experts. Before collecting data, the content validity of the constructs were again identified by Q-sorting and pilot testing. After collecting data, data screening identified missing data and unengaged responses. Tests for statistical assumptions such as normality and homoscedasticity were also conducted. The method of case deletion was adopted to remedy missing data and unengaged responses. The normalisation of indicators was not necessary because the same measurement units (7 point Likert scale) were utilised.

To calculate the indices, CFA2 method for weighting and linear aggregation method for aggregation were adopted respectively. There is not any consensus about superior or preferred methods for deriving weights (Nardo and Saisana, 2008; OECD, 2008). Hence, the choice of weighting method depends on a researcher. FA plays a pivotal role in creating the conceptual and empirical foundation of a summate scale through several tests such as content validity and scale dimension (Hair *et al.*, 2014). A set of weights for the indicators can be provided by FA (Stern *et al.*, 2015). The summation of weighted individual indicators as a linear aggregation method is a common method for computing a composite indicator when an identical measurement unit is utilised (OECD, 2008). UA and SA for robustness and sensitivity of composite indicators are considered unnecessary because intervention following subjective judgement was minimal when the indices were constructed.

OECD (2008) suggests four steps to calculate weights based on PCA and CFA2: checking the correlation structure of the items; the identification of the number of latent factors and selection of factors; rotation of factors; and the calculation of the weights from the rotated factor loadings matrix.

7.5.1 Weights of indicators and sub-constructs of cooperation

Table 7-15 shows the weights of items and factors based on Nicoletti *et al.* (1999) and OECD (2008). The column of squared factor loadings can be calculated by the square of each factor loading. Factor loadings were already achieved by CFA2 (ML and oblimin rotation). The square of factor loading of an indicator represents the variance of the indicator explained by a factor. The weights of item can be computed through the division of the squared factor loadings of each indicator by the variance which each factor explains (OECD, 2008). Therefore, the weight of an item implies the proportion of variance of an indicator explained by a factor within the factor.

When PCA (orthogonal rotation) is conducted, the sum of squared factor loadings of each indicator exactly corresponds to the variance explained by the factor. Therefore, the sum of weights of all items is equal to one. However, CFA2 (ML and oblimin rotation) does not represent the same result. This is because CFA2 considers only the shared variance of a variable whereas PAC considers total variance of a variable (Ford *et al.*, 1986; Osborne and Costello, 2009; Hair *et al.*, 2014). Therefore, CFA2 demonstrates that the sum of squared factor loadings of each indicator is not equal to the variance explained by the factor. Consequently, the sum of item weights does not need to be equal to one. The calculation of the weights of factors is quite straightforward. Each factor weight is the division of the variance a factor accounts for by the variances explained by all factors. To sum up, different methods for the extraction of factors produce different weights (OECD, 2008).

The weights of items and factors in Table 7-15 are achieved based on CFA2. This implies the sum of each squared factor loading of an indicator is not equal to the variance explained by the factor and the sum of weights of items is not equal to one. The weights of items and factors are computed as the following example explains: MUT6 of 0.100 is calculated by 0.918 (squared factor loading of MUT6) / 9.138 (the variance explained by the factor 1) and the weight of factor 1 is obtained by 9.138 / (9.138+8.196+7.666). The factor weights range from 30.7% (*transparency*) to 36.6% (*mutuality*).

Table 7-15 Weights of 15 indicators and three sub-constructs of cooperation

Item	Squared factor loading			Weight of item		
	1	2	3	1	2	3
MUT6	0.918			0.100		
MUT3	0.778			0.085		
MUT7	0.687			0.075		
MUT4	0.650			0.071		
MUT5	0.645			0.071		
MUT8	0.581			0.064		
MUT1	0.321			0.035		
FAI3		0.763			0.093	
FAI4		0.578			0.070	
FAI1		0.488			0.060	
FAI2		0.472			0.058	
TRA3			0.683			0.089
TRA2			0.671			0.088
TRA1			0.427			0.056
TRA4			0.393			0.051
EV*	9.138	8.196	7.666			
WF**	0.366	0.328	0.307			

* Explained Variance implies the variance which the factor explains

** Weight of Factor: the proportion of the variance of a factor divided by the sum of the variances explained by the three factors

7.5.2 Weights of indicators and sub-constructs of collaboration

Table 7-16 represents the 22 weights of items and five weights of sub-constructs of collaboration. Each value is obtained by the same calculation method as the weights of items and factors of cooperation. Among weights of factors, *mutuality* shows the highest value of 24.7%. The lowest weight of 17.2% is assigned to *fairness*.

Table 7-16 Weights of 22 indicators and five sub-constructs of collaboration

Item	Weight of item				
	1	2	3	4	5
FAI3	0.059				
FAI4	0.040				
FAI1	0.033				
FAI2	0.029				
SUS3		0.086			
SUS4		0.069			
SUS2		0.034			
MUT6			0.078		
MUT5			0.060		
MUT3			0.052		
MUT7			0.051		
MTU4			0.043		
MUT8			0.039		
MUT1			0.028		
TRA3				0.074	
TRA2				0.063	
TRA4				0.044	
TRA1				0.043	
TRU3					0.073
TRU2					0.069
TRU1					0.053
TRU4					0.045
EV*	8.734	8.650	12.008	9.534	10.079
WF**	0.172	0.178	0.247	0.196	0.207

* Explained Variance implies the variance which the factor explains
** Weight of factor: the proportion of the variance of a factor divided by the sum of the variances explained by the five factors

7.5.3 Computation of cooperative and collaborative spirit indices

First, a factor score is computed by the weighted average of items:

$$\text{Factor score} = \frac{\sum x_i w_i}{\sum w_i} \qquad [7.1]$$

Where, $\sum w_i$ represents the sum of the weights of an item i. $\sum x_i w_i$ indicates the sum of the multiplications of the average scores of an item i (x_i) and the weights of the item i (w_i). Second, the CCSIs are also calculated by the following weighted average of factors:

$$\text{Index} = \frac{\sum f w_f}{\sum w_f} \qquad [7.2]$$

Where, $\sum w_f$ is the sum of weights of each factor and is equal to 1. $\sum f\, w_f$ indicates the sum of multiplications of factor scores and the weights of each factor. Finally, the index is converted to a scale of zero to 100 to help understanding. Following the procedures, the CSI1 of 55.46 and the CSI2 of 57.23 are computed.

Table 7-17 shows the individual factor indices and overall CCSIs. Among sub-constructs of *cooperation*, *mutuality* scores the lowest whereas *transparency* shows the highest score. The scores of sub-constructs of *collaboration* also represent similar score patterns in the duplicate sub-constructs. Among the five sub-constructs, *trust* records the highest score.

Table 7-17 Overall CCSIs and each factor score

		TRA	FAI	MUT	TRU	SUS
CSI1	55.46	58.83	56.45	50.38	-	-
CSI2	57.23	58.76	56.14	50.61	65.91	56.58

The CCSIs according to types of shipping registered are shown in Table 7-18. The table indicates that the indices of coastal shipping (57.85 in cooperation and 58.92 in collaboration) are rather higher than those of ocean-going shipping (53.36 and 55.75).

Table 7-18 CCSIs according to registered shipping types

		Total	TRA	FAI	MUT	TRU	SUS
Coastal	CSI1	57.85	61.64	59.27	51.79	-	-
	CSI2	58.93	61.61	59.02	52.00	66.54	57.66
Ocean-going	CSI1	53.36	56.35	53.98	49.14	-	-
	CSI2	55.75	56.26	53.62	49.39	65.37	55.63

Table 7-19 represents the indices in terms of types of vessels. The highest indices belong to others (61.15 for *cooperation* and 61.57 for *collaboration*) which are followed by tanker, bulk and container.

Table 7-19 CCSIs sorted by shipping registered and types of vessels

		Total	Container	Bulk	Tanker	Others
Coastal	CSI1	57.85	-	57.70	56.45	59.51
	CSI2	58.93	-	59.50	58.17	59.32
Ocean-going	CSI1	53.36	47.94	52.33	55.02	67.48
	CSI2	55.75	51.99	54.02	57.49	70.25
Total	CSI1	55.46	47.94	54.04	55.86	61.15
	CSI2	57.23	51.99	55.76	57.89	61.57

The indices classified by contract periods are illustrated in Table 7-20. As the contract periods are longer, the CCSIs show greater values.

Table 7-20 CCSIs by shipping registered and contract periods

		Total	Less than 1	1-2	3-9	More than 10
Coastal	CSI1	57.85	53.46	53.69	62.91	67.22
	CSI2	58.93	52.51	56.07	62.76	69.94
Ocean-going	CSI1	53.36	47.58	54.13	59.29	61.79
	CSI2	55.75	50.96	55.78	61.34	63.28
Total	CSI1	55.46	49.51	53.89	61.62	64.12
	CSI2	57.23	51.47	55.94	62.25	66.14

7.5.4 Comparison of differences of cooperative and collaborative spirit indices

The difference between groups across a few dependent variables can simultaneously be tested by MANOVA (Field, 2009). MANOVA is employed to examine the effects of the types of shipping registered, vessel types and contract periods on the CSI1 and CSI2 (two dependent variables).

7.5.4.1 Differences between types of shipping registered

The CCSIs of coastal and ocean-going shipping are demonstrated in Table 7-21. H_6 (*The extent to which shippers of the ocean-going and the coastal shipping industry cooperate and collaborate with their shipping companies will differ)* is tested. In other words, whether the differences between coastal and ocean-going shipping in terms of the CCSIs exist or not is tested through MANOVA. This is because the difference between the two groups can also be assessed through MANOVA (Hair *et al.*, 2014). A quick inspection indicates that the CCSIs of coastal shipping are higher than those of ocean-going shipping.

Table 7-21 CCSIs of coastal and ocean-going shipping

Coastal	CSI1	57.85
	CSI2	58.93
Ocean-going	CSI1	53.36
	CSI2	55.75

With regard to assumptions in MANOVA, the independence of observations was deemed to be ensured because of random sampling (Hair *et al.*, 2014). The univariate normalities of dependent variables were identified by z-values of skewness and kurtosis. The z-scores of skewness and kurtosis of the CSI1 were 0.665 and -0.909 respectively. The CSI2 revealed z-scores of 1.16 for skewness and -1.168 for kurtosis. These scores did not exceed the threshold of |1.96| at the 0.05 level. In other words, the univariate normalities of the two dependent variables were identified at the 0.05 significance level. Hence, any violation from multivariate normality is not of great concern (Hair *et al.*, 2014).

The homogeneity of the variance-covariance matrices among the two groups was identified by Box's test for equality of covariance matrices (multivariate test of homoscedasticity) and Levene's test of homoscedasticity of error variances (univariate test of homoscedasticity). Levene's test for the CCSIs was not significant (i.e. 0.534 and 0.140 respectively). This showed equality of variances between dependent variables across groups. Box's test was also examined because of different group sizes (Field, 2009; Hair *et al.*, 2014). Box's test also showed a non-significant value (0.158) at the 0.05 significance level. This indicates that the variance and covariance matrices between CCSIs are collectively equal across the coastal and ocean-going shipping industry. Therefore, the CCSIs separately and collectively met the assumption of homoscedasticity.

Bartlett's test for sphericity tested whether two dependent variables were significantly correlated or not (Hair *et al.*, 2014). A significant degree of inter-correlation (significance = 0.000) was identified. The number of observations in each group exceeded the number of dependent variables (two). Hence sample size satisfied the bare minimum (Hair *et al.*, 2014).

The four multivariate test statistics with the same value represented that the CCSIs do not have a significant difference (0.109 at the 0.05 significance level) between the two business types of shipping. Main effect and power of business types of shipping showed low values (i.e. 0.027 and 0.452 respectively). For example, PT showed V (value) = 0.027, F (2, 164) = 2.245, p (0.109) > 0.1, η^2 = 0.027, P (power) = 0.452. The univariate tests for the each dependent variable also indicated no significant difference between coastal and ocean-going shipping (significance = 0.117 for cooperation and 0.240 for collaboration respectively). A *post hoc* test was not conducted because only two groups exist (Hair *et al.*, 2014).

In summary, the CCSIs between coastal and ocean-going shipping do not indicate any statistically significant differences. Hence, H_6 is rejected.

7.5.4.2 Differences among vessel types and contract periods

The possibility of joint effects and main effects of vessel types and contract periods on the CCSIs were examined through MANOVA. The following hypotheses were tested.

H_7. The extent to which shippers of different types of vessels cooperate and collaborate with their shipping companies will differ.

H_8. Different contract periods will show different levels of cooperation and collaboration between shippers and shipping companies.

H_9. Different types of vessels along with different contract periods will show different levels of cooperation and collaboration between shippers and shipping companies.

The CCSIs along with vessel types and contracts periods are demonstrated in Table 7-22. With regard to vessel types, the indices show a persistent pattern: the scores of others are the highest and followed by tanker, bulk and container. In the case of contract periods, the abiding pattern is more prominent: “more than 10 years” contract period has the highest score and as the contract period is shorter, the score becomes lower. As seen on the left side of Table 7-22, the CCSIs of vessel types making allowance for contract period simultaneously also indicate consistent pattern except for the decreasing values from “less than 1” (58.48, 57.54) to “1-2” (54.83, 56.47) in the “others” row. However, the decrease can be deemed negligible. As the contract period become longer, the CCSIs of vessel types grow steadily, which shows again that the CCSIs of vessel types are closely related to contract period.

Table 7-22 CCSIs by vessel types and contract periods

	CSI1	CSI2		CSI1	CSI2
Container	47.94	51.99	Less than 1	49.51	51.47
less than 1	45.70	49.76	Container	45.70	49.76
1-2	54.66	58.66	Bulk	46.27	48.37
3-9	-	-	Tanker	47.81	51.17
more than 10	-	-	Others	58.48	57.54
Bulk	54.04	55.76	1-2	53.89	55.94
less than 1	46.27	48.37	Container	54.66	58.66
1-2	54.25	56.29	Bulk	54.25	56.29
3-9	56.49	57.04	Tanker	52.93	54.85
more than 10	60.52	62.14	Others	54.83	56.47
Tanker	55.86	57.89	3-9	61.62	62.25
less than 1	47.81	51.17	Container	-	-
1-2	52.93	54.85	Bulk	56.49	57.04
3-9	59.39	60.13	Tanker	59.39	60.13
more than 10	70.45	73.89	Others	77.09	77.59
Others	61.15	61.57	More than 10	64.12	66.14
less than 1	58.48	57.54	Container	-	-
1-2	54.83	56.47	Bulk	60.52	62.14
3-9	77.09	77.59	Tanker	70.45	73.89
more than 10	81.12	82.84	Others	81.12	82.84

Given four categories of vessel types and contract periods, 16 groups were created. The sample size also satisfied the minimum criterion recommended by Hair *et al.* (2014). In addition, if the homogeneity of variance-covariance matrices across groups is met, the results of MANOVA can directly be interpreted regardless of group sizes (Hair *et al.*, 2014).

Using Box's test (0.120 of significance), the null hypothesis of equality of variance-covariance matrices was accepted at the 0.05 level. Levene's test for CCSIs showed non-significant values of 0.815 for cooperation and 0.974 for collaboration respectively. The results of the multivariate and univariate tests indicated that the assumption of homoscedasticity was fully met.

Multivariate test statistics showed that the interaction effect between vessel types and contract periods is not significant (e.g. PT V = 0.065, F (14, 306) = 0.735, p = 0.738, η^2 = 0.33, P (power) = 0.469). This implies that H_9 should be rejected. Hence, the direct effects were straight examined without any adjustment (Hair *et al.*, 2014).

In terms of multivariate tests, among the four multivariate test statistics, PT was used because of different group sizes. When group sizes are different, PT is recommended (Field, 2009; Hair *et al.*, 2014). PT demonstrated that there were the following significant effects of contract periods and vessel types on the CCSIs: contract period, V = 0.129, F (6, 306) = 3.512, p (0.002) < 0.01, η^2 = 0.64, P (power) = 0.948; vessel types, V = 0.081, F (6, 306) = 2.166, p (0.046) < 0.05, η^2 = 0.41, P (power) = 0.767. The power of contract periods was deemed good (Hair *et al.*, 2014) and that of vessel types are acceptable and adequate (Stevens, 1980). Therefore, H_7 and H_8 are supported. The impact of the two independent variables can be compared by the value of η^2. According to the values of η^2, contact periods have more effect on the CCSIs than vessel types.

Although there are some arguments about the use of individual ANOVAs as a *post hoc* test (Huberty and Morris, 1989), many researchers follow the procedures of the first MANOVA and the follow-up individual ANOVAs (Warne, 2014). Hence, the follow-up univariate ANOVAs on the dependent variables were also examined. The results of ANOVA likewise revealed significant effects of contract periods and vessel types on the CCSIs. In terms of the CSI1, the results were as follows: contract periods, $F (13, 153) = 6.234$, $p < 0.001$; vessel types, $F (13, 153) = 2.880$, $p < 0.05$. With regard to the CSI2, contract periods with $F (13, 153) = 6.872$ and $p < 0.001$ and vessel types with $F (13, 153) = 2.839$ and $p < 0.05$ were revealed. The values of p in tests of "Between-Subjects Effects" indicated that there were significant differences between groups in terms of contract periods and vessel types. From these results of multivariate and univariate tests, it can be concluded that the CCSIs are significantly affected by contract periods and vessel types.

Post hoc tests were also conducted because the multivariate and univariate tests did not illuminate whether some groups differ from other groups on the CCSIs. Comparisons among groups were conducted based on Tukey LSD test of significance. In terms of effects of contract periods on the CSI1, the "less than 1 year" group represented a significant difference with "3-9 years" and "more than 10 years" groups at the 0.05 significance level (significance = 0.003 between "less than 1" and "3-9 years" groups and 0.000 between" less than 1" and "more than 10 years" groups). The "1-2 years" group showed significant discrimination with the "more than 10 years" group (significance of 0.013). The difference between "3-9 years" and "less than 1 year" groups was significant with the significance value of 0.003. Finally, the "more than 10 years" group was different from "less than 1 year" group with a significance value of 0.000 and "1-2 years" group with 0.013. The effects of contract periods on the CSI2 demonstrated the same pattern as the CSI1. Table 7-23 shows the differences among groups according to contract periods which are statistically significant.

Table 7-23 *Post hoc* pair-wise comparisons between contract periods in terms of dependent variables with Tukey LSD

Dependent variables	Comparison among groups in independent variable		Significance
CSI1	less than 1 year	1-2 years	0.188
		3-9 years	0.003
		more than 10 years	0.000
	1-2 years	less than 1 year	0.188
		3-9 years	0.058
		more than 10 years	0.013
	3-9 years	less than 1 year	0.003
		1-2 years	0.058
		more than 10 years	0.594
	more than 10 years	less than 1 year	0.000
		1-2 years	0.013
		3-9 years	0.594
CSI2	less than 1 year	1-2 years	0.157
		3-9 years	0.006
		more than 10 years	0.000
	1-2 years	less than 1 year	0.157
		3-9 years	0.100
		more than 10 years	0.008
	3-9 years	less than 1 year	0.006
		1-2 years	0.100
		more than 10 years	0.380
	more than 10 years	less than 1 year	0.000
		1-2 years	0.008
		3-9 years	0.380

With regard to the effect of vessel types on the CSI1, "container" was significantly different to "other groups" at the 0.05 significance level (significance value of 0.014). The difference between "bulk" and "others" (significance value of 0.056) was marginally significant. The other significance differences were not detected. In terms of the CSI2, the difference between “container” and “others” (significance value of 0.058) showed a marginal significance. Any other differences of vessel types in terms of the CSI2 were not revealed. The differences among vessel types in terms of the CCSIs are shown in Table 7-24.

Table 7-24 *Post hoc* pair-wise comparisons among vessel types in terms of dependent variables with Tukey LSD

Dependent variables	Comparison among groups in independent variable		Significance
CSI1	container	bulk	0.213
		tanker	0.116
		others	0.014
	bulk	container	0.213
		tanker	0.576
		others	0.056
	tanker	container	0.116
		bulk	0.576
		others	0.174
	others	container	0.014
		bulk	0.056
		tanker	0.174
CSI2	container	bulk	0.416
		tanker	0.215
		others	0.058
	bulk	container	0.416
		tanker	0.489
		others	0.098
	tanker	container	0.215
		bulk	0.489
		others	0.317
	others	container	0.058
		bulk	0.098
		tanker	0.317

7.6 Summary

In this chapter, to identify common factors underlying 24 items which were developed in Chapter Five, EFA and CFA1 were utilised. EFA also played a pivotal role in calculating CCSIs by producing the weights of factors and items. EFA and CFA1 verified five sub-constructs and 22 items for collaboration and three sub-constructs and 15 items for cooperation. CFA1 verified the construct validity including reliability and supported the measurement models as shown in Figure 7-1 and 7-2. *T* coefficient also supported that the second order factors, viz. cooperation and collaboration exist and the second order models are efficient. The structural or theoretical models as depicted in Figure 3-2, 7-5, and 7-6 were supported by path analysis however the postulated dependence relationship between transparency and trust (H_2) was rejected. Overall CCSIs and several CCSIs according to shipping registered, vessel types and contract periods were calculated through weighted average formulas. The CCSIs across shipping registered showed that the indices of coastal shipping are slightly greater than those of ocean-going shipping. The CCSIs according to vessel types indicated that the greatest values belong to “others” followed by tanker, bulk and container. The CCSIs in terms of contract periods revealed that longer contract periods have greater values of CCSIs. MANOVA provides the evidence of the differences of CCSIs across vessel types and contract periods.

On the basis of these empirical results, the next chapter discusses contributions and implications of this research in terms of theory, industry and policy. Some suggestions are also proposed. For future research, limitations of this research are pointed out and subsequently some recommendations are made.

Chapter 8 Discussion

This chapter evaluates the present state of cooperation and collaboration between shippers and shipping companies which is a case study of collaboration in SCs through synthesising previous discussions. Some suggestions to improve the present situation are also made. How this research can span inter-firm collaborative relationships within SCs is discussed. First, the findings of this research are addressed in Section One. Five ROs and the corresponding results of research hypotheses are synthesised. The components of both *cooperation* and *collaboration* (RO one) are suggested. The significance of hypotheses (H_1 to H_5) tests connected with the relationships among the components (RO two) are also provided. Explanations of the scope for slightly negative links between *transparency* and *trust* are offered. The CCSIs and relevant hypotheses (H_6 to H_9) (RO three and four) are addressed. The CCSIs (RO five) are evaluated. Section Two explains how this study contributes to theories, and helps to operationalise key concepts. Implications for management and policy are suggested. To enhance cooperation and collaboration between shippers and shipping companies, various endeavours or measures involving shippers, shipping companies, and a government are discussed, which achieves RO six. Finally, some limitations of this research are provided in Section Three. The section contains some recommendations for further study in line with limitations of this research. It is also recommended that because each inter-firm relationship in SCs has distinctive features, this research model and CCSIs should be cautiously applied to other inter-firm activities and relationships.

8.1 Research findings

To achieve the main purpose of this study i.e. suggesting the criteria to diagnose, analyse and evaluate the extent to which the relationship between SC members is cooperative and collaborative as a case of research concerning the SCC, the following ROs were provided in Chapter One:

RO1: To identify components of the cooperative and collaborative relationship between shipping companies and shippers from the point of view of deep-sea and coastal shipping companies.

RO2: To explore correlations among components of the cooperative and collaborative relationship between shipping companies and shippers.

RO3: To create indices to measure the cooperative and collaborative relationship - including the indices of ocean-going and coastal shipping and the indices by sub-shipping industries (container, bulk, tanker, and others).

RO4: To identify the differences of indices according to types of shipping registered, sub-shipping industries and other variables

RO5: To evaluate the extent of cooperation and collaboration between shipping companies and shippers through the indices scores.

RO6: To recommend how to enhance or foster the cooperative and collaborative relationship between them based on the indices scores.

In line with the above objectives, the following hypotheses were established in Chapter Three.

H_1. There is a positive relationship between cooperation and trust.

H_2. There is a positive relationship between transparency and trust.

H_3. There is a positive relationship between fairness and trust.

H_4. There is a positive relationship between mutuality and trust.

H_5. There is a positive relationship between trust and sustainability.

H_6. The extent to which shippers of the ocean-going and the coastal shipping industry cooperate and collaborate with their shipping companies will differ.

H_7. The extent to which shippers of different types of vessels cooperate and collaborate with their shipping companies will differ.

H_8. Different contract periods will show different levels of cooperation and collaboration between shippers and shipping companies.

H_9. Different types of vessels along with different contract periods will show different levels of cooperation and collaboration between shippers and shipping companies.

RO1 and RO2 were considered in Chapter Two and Three which reviewed literature and developed a conceptual model in the SCM context. Corresponding hypotheses from H_1 to H_5 were established in Chapter Three and were tested in Chapter Seven using SEM. RO3 and RO4 were addressed in Chapter Two and Seven. Chapter Seven contains the creation of and the differences among the CCSIs and the tests of hypotheses from H_6 to H_9 utilising MANOVA. RO5 and RO6 are considered in this chapter.

8.1.1 The components of cooperation and collaboration (research objective one)

This research postulates that *cooperation* can conceptually be differentiated from *collaboration* and is a subset of *collaboration*. Such a definition of *cooperation* as a transparent business partnership process where partners work together treating each partner justly and equally on the basis of mutuality for common goals and benefits was suggested. *Collaboration* was defined as a business partnership process where partners aim to sustain a long-term cooperative relationship based on trust between them.

The composites of *cooperation* and *collaboration* and each indicator of the composites were first derived from theories of cooperation, SCM and inter-firm relations literature. The composites and their indicators were adapted to suit the context of maritime logistics through email interviews, content analysis, two-round Q-sorting, and pilot testing. The content validity of each dimension and indicator was good.

The instrument to measure *collaboration* and *cooperation* was conceptualised using five and three dimensions respectively. Showing good model fit and statistically significant factor loadings of each indicator, a CFA1 test for first-order factors supported the convergent and discriminant validity. These provided strong evidence of a close relationship between the first-order factors and their corresponding indicators.

Furthermore, the good scores of target coefficient (*T*) suggested evidence for the existence of the second-order factors, *cooperation* and *collaboration*. The target coefficient (*T*) supported *cooperation* and *collaboration* as multi-dimensional constructs, composed of several first-order factors.

Empirical evidence revealed that *cooperation* is comprised of *transparency*, *fairness*, and *mutuality* and *collaboration* consists of *cooperation*, *trust*, and *sustainability*.

Given that *fairness* has the highest variation explained by *cooperation* (87%) and *collaboration* (86%) in each corresponding measurement model, it can be inferred that shipping companies value *fairness* above the other components of cooperation and collaboration.

Transparency was identified to be comprised of (1) exchange of relevant and timely information, (2) smooth communication through various channels, (3) open and two-way communication, (4) previously and clearly setting-up of the relationship by prior agreement.

Fairness, another name for justice (Konovsky, 2000) or reciprocity (Bensaou, 1997) consists of procedural and distributive justice. The concept was recognised as containing no discrimination, the observation of fair trade laws, the guarantee of reasonable and just profits, and reasonable and just bearing of burdens.

Mutuality, namely exchange relationship, was verified to involve such notions as understanding of the services of the other partner, common implementation plans/objectives, common identification of customer's needs, common performance measurement, providing adequate assistance to overcome any difficulties including financial support.

It was also revealed that *trust* can be measured by trustworthiness and good faith of the other party, fulfilment of obligation and benevolence.

Finally, *sustainability*, a similar concept to "relationship extendedness" of Gardner *et al.*'s (1994), was ascertained to be well represented by the belief on the continuity of relationship and by the other partner's willingness to maintain and enhance the relationship.

8.1.2 The correlations of components of cooperation and collaboration (research objective two)

The hypotheses from H_1 to H_5 were proposed on the basis of the structural relationships among sub-constructs of *cooperation* and *collaboration* discussed in Chapter Three. The hypotheses were tested with path analysis in Chapter Seven. The structural model supported hypotheses H_3, H_4, and H_5 with significant and positive path estimates (0.501, 0.424, and 0.793 respectively) whereas the dependence relationship of *trust* from *transparency*, the hypothesis H_2 was rejected with a non-significant and slightly negative estimate (-0.057). Hence, it can be interpreted that *fairness* and *mutuality* directly affect *trust* whereas *transparency* has a slightly negative effect on *trust*.

This slightly negative direction (-0.057) from *transparency* to *trust* can be explained in two ways.

First, the possibility of reverse causality between *transparency* and *trust* exists. *Trust* also can influence positively higher levels of information sharing and quality (Li and Lin, 2006).

Second, it cannot be denied that formalisation, detailing roles and expectations can play an important role in SCs given that not all partners in SCs have equal power in terms of their relationship (Daugherty *et al.*, 2006). However, with regard to question four (the cooperative and collaborative relationship between shippers and our firm is understood clearly and transparently through prior agreements) included in *transparency*, an expert suggested the follwoing: "*shippers tend to favour the simplest contract within the legal boundaries. A number of additional requests which are not included in the written contract are inclined to be asked verbally on the phone or in bilateral meetings. In reality, the requests cannot be ignored in the light of superior status of the shippers*". Under such circumstances, although simple agreements can be clearly and transparently understood between SC members, the agreements can rather hinder trust building within the SC.

Through the interview, it can also be inferred that frequent contact through various channels with more powerful members can burden weaker partners. This inference is related to question two included in *transparency* (Shippers and our firm communicate smoothly with each other through various channels such as regular or casual meeting between executives or between staffs). Therefore, it seems rational to conclude that *transparency* does not necessarily lead to the improvement of *trust*. Rather, *transparency* can bring about the decline of *trust* between parties who have not yet generated and developed trust between them.

The structural model of first-order factors for *collaboration* confirmed that the greatest impact on *trust* belonged to *fairness* and was followed by *mutuality*. This implies that the weaker members in the SC consider *fairness* as the most essential antecedent of *trust* as well as the most important component. As expected, *sustainability* was tremendously affected by *trust*.

The hypothesis H_1 was also tested by the structural model with the second-order factor, *cooperation*. A significant path coefficient (0.86) from *cooperation* to *trust* confirmed the hypothesis. *Cooperation* was identified to affect positively *trust*.

Therefore, to summarise the above discussion, it can be construed that although *transparency* can affect *trust* slightly negatively, once *cooperation* has been established through *transparency, fairness*, and *mutuality, trust* can be fostered and enhanced by the *cooperation*. It was also already verified that *trust* as a mediator leads to *sustainability*. Hence, it can be said that a cooperative SC can be sustainable in a long-term manner when the inter-firm relationships in the SC are based on *trust*. The trust can be acquired when the relationship is transparent, fair, and on the basis of mutuality.

8.1.3 The cooperative and collaborative spirit indices (research objectives three and four)

Summated scales, and weighted averages of indicators and factors, were utilised to calculate the CCSIs. For the summated scales, CFA2 with ML and oblimin rotation methods, rather than PCA with orthogonal rotation, was adopted. The adoption was in accordance with the recommendations of various authors (Graham *et al.*, 2003; Osborne and Costello, 2009; Pedhazur and Schmelkin, 2013; Hair *et al.*, 2014). According to them, the CFA2 is a better method than the PCA in that CFA2 considers the segmentation of variance and is preferred when factors and items are intercorrelated. It was revealed that because PCA takes into account total variance of a variable whereas CFA2 considers shared variance, the two methods did not show the same results in terms of the summed scores of squared factor loadings and weights of all items. The weights of items and factors for CCSIs were produced on the basis of the variances which the results of CFA2 represent.

The cooperation and collaboration between SC members represented the CSI1 of 55.46 and CSI2 of 57.23. According to Table 7-17, *transparency* such as *information sharing* and *frequent contact* in the SC is considered relatively good whereas *mutuality* such as *resource sharing* and *general support* seems to be unsatisfactory from the viewpoint of shipping companies.

Fairness which is considered to be the most important component of *cooperation* and *collaboration* represented the second highest scores among three components of *cooperation* and the fourth among five components of *collaboration* respectively.

Although the indices of the components are not high, shipping companies displayed a relatively high score (65.91) of *trust* towards their dominant SC partners.

According to CCSIs by shipping types registered, it appeared that coastal shipping companies (57.85 and 58.93) regarded their powerful SC partners as having more cooperative and collaborative attitudes than ocean-going shipping companies (53.36 and 55.75). Especially, coastal shipping companies set relatively high values for *transparency* and *fairness* compared to ocean-going shipping companies.

Although it apparently seemed that the difference between the two types of shipping companies exists, the difference was not supported by the empirical test, MANOVA. That is why hypothesis 6 was rejected. In other words, it was revealed that Korean shipping companies regardless of the types of shipping registered considered the cooperative and collaborative attitudes of their shippers as not very high.

Meanwhile, the MANOVA showed statistically significant differences among the CCSIs in terms of vessel types and contract periods. Thus, hypotheses H_7 and H_8 were accepted. Table 8-1 below presents the CCSIs with other criteria and the outcomes of hypothesis tests.

Table 8-1 CCSIs by different variables and the results of hypothesis tests

	CSI1	CSI2	Hypothesis	Reject/Accept
The SC	55.46	57.23	-	-
Shipping types registered				
Coastal	57.85	58.93	H_6	Rejected
Ocean-going	53.36	55.75		
Vessel types				
Container	47.94	51.99	H_7	Accepted
Bulk	54.04	55.76		
Tanker	55.86	57.89		
Others	61.15	61.57		
Contract period				
Less than 1	49.51	51.47	H_8	Accepted
1-2	53.89	55.94		
3-9	61.62	62.25		
More than 10	64.12	66.14		

The joint effects of vessel types and contract periods on CCSIs did not indicate any significant differences. That is why hypothesis H_9 was rejected.

The differences between container (47.94 and 51.99) and others (61.15 and 61.57) among vessel types were the most distinctive. More long-term contract periods represented higher CCSIs. The differences of CCSIs are noticeable between contract periods of “less than 1” and “over 3 years”.

Although vessel types and contract period have a relatively close relationship and each of them shows significant difference in terms of CCSIs, it is more rational to comprehend that contract period affects the CCSIs more closely and consistently than types of vessels. This is because the contract period regardless of vessel types shows a consistent trend of CCSIs whereas vessel types considering contract period concurrently do not show a coherent tendency as much as the contract period. This can be explained by the fact that most container shipping companies unquestionably have short-term contracts with shippers whereas bulk and tanker carriers show mixed i.e. both short and long-term contracts.

For example, the shippers’ purchase of freight services from container shipping companies usually is based on one-year contracts (Frémont, 2009; Fransoo and Lee, 2013). However, the contracts with freight forwarders such as NVOCC (another type of shipper) show a relatively shorter period from one to three months (Fransoo and Lee, 2013). In bulk shipping, seasonal commodities such as grain and heavy plant have a single voyage contract whereas bulk carriers transporting iron ore and motor cars show long-term contracts with shippers (Stopford, 2009).

These intertwined and inconsistent contract periods along with vessel types can once again be identified in Table 6-7. As shown in the Table, even though 79.4% of others have short-term contracts of “less than 2 years”, the other types of vessels have higher CCSIs than any other vessel types as shown in Table 8-1.

Hence, it can also be more reasonable to deem that although contract period clearly and coherently affects CCSIs of different kinds of vessels, the contract period is just one of several ingredients which can have effects on the CCSIs by the vessel types. Other elements such as a variety of kinds of shippers and different characteristics of different shippers can explain the different CCSIs according to types of vessels as well.

8.1.4 Evaluation of the cooperative and collaborative spirit indices (research objective five)

The CCSIs have great significance in that they can function as evaluative criteria for the current situation of cooperation and collaboration in the SC and can indicate strategies for better cooperation and collaboration between SC members.

First, overall CCSIs indicate that cooperative and collaborative attitudes of the influential SC members receive very modest evaluation by the weaker partners.

Among the components of CCSIs, *mutuality* obtained the lowest score. Notably, shipping companies thought that their shippers fall short on financial support and assistance to overcome difficulties which they are confronting. Furthermore, common implementation planning and performance review also were considered not to work well between the SC members. The lowest score of *mutuality* reflects exchange relationships, the most fundamental element of cooperation and collaboration, which is not rooted firmly in the SC.

With regard to *fairness*, which showed the second lowest score among components of CCSIs, distributive fairness is deemed less applicable than procedural fairness. Shipping companies regarded the reasonable and just guaranteeing of profits and reasonable and just bearing of additional burdens of the powerful SC members as not sufficient. It seems that low scores on attitudes of the dominant partners towards sharing gains and costs decrease the satisfaction levels of cooperation of shipping companies (Harland *et al.*, 2004) and hinder the building of trust and true cooperation between SC members.

Regarding *sustainability*, which recorded the third lowest score, it was revealed that the influential members lack interest in “relationship extendedness” such as the joint development of new business plans or the joint expansion of new markets. Hence, it seems that shipping companies cannot fully be confident of extended relationships with their shipper.

Concerning *transparency* which gained relatively high scores, open and two-way communication turned out to be insufficient in the SC. The shortage of open and two-way communication between SC members can be regarded as mirroring the superior power of shippers.

In spite of the relatively low CCSIs, the weaker SC members showed a relatively strong trust towards the superior partners. Especially, shipping companies believe firmly in the fulfilment of contractual obligation of shippers. Additionally, the regulations related to business transactions and the laws related to fair trade showed a relatively high degree of observance by the powerful members.

To sum up, the following evaluation is possible: In the SC, cooperation and collaboration exists at very modest levels. The lack of spirit of *mutuality,* *distributive fairness*, “relationship extendedness”, and *two-way communication* is affecting negatively the building of higher levels of cooperative and collaborative relationships between the SC members.

8.2 Implications for theory, industry and policy

8.2.1 Contributions to theories

This research identifies the possibility of the existence of benign and credible transactions between SC members from the view of recent TCT. According to Heaver (2015), the logistics chain members are moving towards more benign or credible transactions compared with the typical “muscular” approach. The extended TCT explains cooperation among companies as an alternative mode of transactional governance which decreases transaction costs and realises mutual gains. The hybrid transactions can be grouped into “muscular”, “benign”, and “credible”. “Muscular” types of transaction presume that a more powerful party treats peremptorily the other weaker party. In a “benign” approach, the requisite cooperation is ongoing and power is replaced by trust however the approach lacks flexibility regarding unanticipated events (Williamson, 2008, p.10). The “credible” approach contains the agreement of the two parties regarding appropriate measures to deal with unforeseen conditions (Williamson, 2008; Heaver, 2015).

Given the superiority of shippers and the overall modest CCSIs, market or “muscular” transactions are presumed to still predominate in SCs. However, the existence of long-term contracts and corresponding higher CCSIs also indicates that "benign" and "credible" transactions also exist. To recapitulate, this research examined the probability of adaption of hybrid forms of governance among transactions of TCT in SCs and found positive evidence of "benign" and "credible" transactions.

The key constructs of RBT are resource and capability (Yang *et al.*, 2009). Capability implies the ability of a firm to develop, deploy and integrate its resources to generate value, whereupon resources are a fundamental foundation of capability. The two major components compose a firm's strategic assets which furnish the firm with a sustainable competitive advantage (Amit and Schoemaker, 1993).

From the perspective of RBT, the extent of cooperation and collaboration in SCs can be regarded as one of the intangible resources and capabilities which can be included in strategic assets of SC members. Hence, in connection with RBT, this research can provide a comprehension that shipping companies with higher CCSIs can be considered to have a competitive advantage in terms of cooperation and collaboration. Given the great dependence of the weaker SC members' revenues on shippers and general characteristics of cooperation and collaboration accumulated over a period of time, shipping companies with higher CCSIs can be deemed to have a relatively higher competitive advantage compared to other shipping companies with lower CCSIs.

Although RDT emphasises cooperation and support among SC members for competition in the market and sustainable development (Ulrich and Barney, 1984; Ramanathan and Gunasekaran, 2014), one of the major characteristics of RDT is that power relations based on exchange of resources are involved in the relationships among companies (Ulrich and Barney, 1984). “Organisations attempt to reduce others’ power over them, often attempting to increase their own power over others” (Hillman *et al.*, 2009, p.1404). Although the above assumption of RDT cannot be totally applicable to shippers, this perspective of RDT is capable of explaining the dominant SC members’ attitudes to some extent.

In the SC, shippers need to cooperate and collaborate with shipping companies for resources related to shipping services and at the same time, they can easily switch their carriers in the extremely competitive shipping industry (Golicic, 2007). In this context, the different scores of CCSIs according to vessel types show that shippers, taking into account the types of vessels, are exerting their power efficiently towards the weaker SC members. The lowest CCSIs for containers can indicate that shippers of container vessels are effectively reducing the shipping lines’ power over them or their dependence on shipping lines. To put it another way, through the CCSIs, the degree of dependence of shippers on, or power over shipping companies, can be partially estimated.

SET provides great inspiration for developing the conceptual model of this research especially in that fairness, one major component representing cooperation leads to trust, commitment (Folger and Konovsky, 1989; Korsgaard et al., 1995) and long-term orientation (Griffith et al., 2006) and in that the persistence and extendedness of social exchange depends on trust (Zafirovski, 2005).

This research adapted the essential concepts of SET such as *fairness, trust, commitment, and long-term orientation* within the context of the maritime logistics chain. The greatest value of path coefficient of *fairness* indicated that the weaker SC members regard *fairness* as the most pivotal antecedent of *trust*. Besides, the proposition that *trust* has direct and positive effect on *sustainability* (path coefficient of 0.79) which contains the concepts of commitment and long-term orientation was supported by SEM. In this sense, the significance of this study in terms of SET is that the essential conceptions of SET were adapted within the context of the maritime logistics chain and the relationships among the concepts were strongly supported.

From SCT, Adler and Kwon (2002) classify a relation into market, hierarchical and social relations and define social capital as “the goodwill available to individuals or groups. Its source lies in the structure and content of the actor’s social relations” (p.23). According to them, “goodwill” encompasses sympathy, trust and forgiveness provided for us and “social relations” imply the relations which underlie social capital and in which favours and gifts are interchanged.

In this context, the CCSIs provide a criterion to define the type of relations in the SC and correspondingly of the extent of goodwill. In light of the lowest CCSIs attaining in container shipping, it can be inferred that market or hierarchical relations between the SC members are widespread and the substance of social capital, goodwill of shippers towards shipping lines is insufficient or unsatisfactory.

8.2.2 Additional contributions

Apart from some direct contributions to theories, this research helped to clarify operationalisation of some key concepts.

First of all, as discussed in Chapter Three, most literature about SC cooperation or collaboration has not differentiated between cooperation and collaboration whereas this research distinguishes the two concepts in line with the opinions of Spekman *et al.* (1998) and Golicic *et al.* (2003). The views of the two authors about the differentiation of cooperation from collaboration are crystallised in this research in that *collaboration* consists of *cooperation* and "relationship strength" such as *trust* and *sustainability*.

To put it another way, the discrimination between *cooperation* and *collaboration* depends on the existence of *trust* and *sustainability*. *Sustainability* is analogous to "relationship extendedness" and contains key concepts such as commitment and long-term orientation. Hence, a cooperative relationship can be named as a collaborative or truly cooperative relationship when the cooperative relationship is based on trust, commitment and long-term orientation. With this consideration, the CCSIs were achieved.

Second, it can be pointed out that the items were considerately developed by industrial experts and content analysis. As discussed in Chapter Five, although the initial 82 items were mainly derived from extant SCM disciplines literature, the probability of adaption of the items into the context of maritime logistics chains was rigorously examined. The 24 items representing collaboration which were considered adaptable to SCs were carefully chosen through the elaborate procedures mentioned earlier in Chapter Five.

This research also can be distinguished from other literature in that first order factors consisting of a few concepts are utilised to measure *cooperation* and *collaboration*. Specifically, *transparency* is comprised of *information sharing,* *communication,* and *formalisation*. *Procedural* and *distributive justices* are included in *fairness*. *Mutuality* contains *goal congruence, resource sharing, joint problem solving* and *performance measurement* and *knowledge creation*. *Trustworthiness, good faith,* c*redibility* and *benevolence* compose *trust*. *Commitment* and *long-term relationship* explain *sustainability*.

This research shows that even though first order factors are composite constructs containing several concepts, the factors do not have any difficulty in representing and measuring higher order factors. Many first order factors would correspondingly have many questions. Completion of the large number of survey questions would be demanding on the respondents (Hair *et al.*, 2014). This is the main reason why, as shown in Chapter Five, this research attempted to reduce the number of items and the orders of factors through elimination of irrelevant items or merging items and factors with similar meaning into one item and factor instead of adapting items and factors of other authors as they are.

Another contribution of this research is the overt introduction of *fairness* as one component of *cooperation* and *collaboration*. Although some authors utilise “incentive alignment” as one component of *collaboration*, “incentive alignment” implies only *distributive fairness*. Given that there exists an argument that *procedural fairness* is more crucial than *distributive justice* in building cooperative relationship (Tyler and Lind, 1992; Kumar *et al.*, 1995b), the two facets of *fairness* were simultaneously adapted. Empirical analysis also supported the importance of *fairness*: the weaker SC members considered *fairness* as the most vital element of *cooperation*. *Fairness* also exerted the most powerful influence on building *trust* among components of *cooperation*.

Finally, the possibility that *trust* cannot necessarily be ameliorated by *transparency* was identified as discussed in 8.1.2.

8.2.3 Managerial implications (research objective six)

Generally, in the logistics chain, shipping companies are deemed weaker than shippers. When suppliers such as shipping companies offer a service that can easily be duplicated by other suppliers and a large portion of their revenues accrues from customers such as shippers, suppliers depend more on customers than the customers do. Hence, carriers want stronger relationships with their shippers than shippers do (Golicic, 2007). However, shippers have also been requested to provide high-quality, cost-effective delivery systems as well as quality products. The delivery system now constitutes an indispensable part of product provision (Kleinsorge *et al.*, 1991).

In this vein, the powerful SC members need to remember that in the circumstance of increasing global competition, “the competition means that there is more to be gained by focusing on increasing the efficiency and competitiveness of the chain than on increasing the share of the profits in the chain” (Heaver, 2015, p.286). Further “In an age where firm-to-firm competition seems to be giving way to SC-to-SC competition, firms must find ways to collaborate for the long haul if they hope to survive, grow and flourish” (Daugherty *et al.*, 2006, p.67).

In this sense, the dominant SC members should endeavour to balance between self-interest and interdependency to ameliorate overall performance of the SC (Richey *et al.*, 2010). To put it another way, even from the stances of the powerful SC members, cooperation and collaboration with the weaker members is essential for their survival and growth. Confronting unprecedented competition, risks and uncertainties caused by globalisation, some firms in international SC have initiated several activities for better visibility, reliability, agility, and collaboration along the SC (Heaver, 2015).

In the evaluation of the CCSIs, the insufficiency of spirits of *mutuality, distributive fairness,* "relationship extendedness"*, and two-way communication* were particularly pointed out as the obstacles to establishing cooperative and collaborative SCs.

The collapse of a shipping company can cause a lot of damage to SC members, especially shippers. For example, Hanjin Shipping Company's bankruptcy caused huge losses for shippers. As of 14th November 2016, the estimated losses to 329 shippers caused by Hanjin's collapse have amounted to 120 million dollars. Hanjin's collapse led to delivery delay and contract destruction. Recently, shippers wasted resources in trying to find appropriate shipping transport service providers and a rising freight rate (KITA, 2017).

Hence, it is very important for the powerful SC members to recognise that the ordered maintenance of cooperation and collaboration with the other weaker members can be beneficial to themselves in the long run. In this regard, shippers should actively consider providing assistance including financial support to help shipping companies to overcome their own difficulties.

The influential SC members also need to make efforts to settle common cooperative and collaborative implementation plans and to review performance with the weaker partners on the basis of two-way communication. Such endeavours of shippers can enhance exchange relationships in the SC and help themselves to find opportunities and fields for improvement (Min *et al.*, 2005). However, the dominant members should keep in mind that frequent contact can burden their weaker SC partners. After a cooperative relationship in the SC is established, frequent contact should be rationalised and justified.

It is also emphasised that although shipping companies set the highest value on fairness and fairness is a key element of building trust, distributive fairness of the influential members falls short of the expectations of the weaker members. “Although powerful manufacturers may have the ability to take advantage of vulnerable resellers by dictating dealer margins as well as instituting procedures that favour themselves, this may not be the wisest course. The impact of fairness on dealer perceptions must be considered if developing stable, effective channel partnerships is a goal” (Kumar *et al.*, 1995a, p.63). “Because vulnerable resellers often have few avenues for redress, those who are subjected to unfairness are likely to experience hostility toward the supplier. Thus, supplier unfairness is likely to have a detrimental impact on relationship quality.” (Kumar *et al.*, 1995a, p.55).

These lessons can be adapted to the relationship between the SC members, i.e. shippers and shipping companies. Therefore, the stronger SC members should endeavour to share profits and burdens with the weaker partners to develop an effective and high quality relationship. Besides, sharing benefits and burdens between partners plays a pivotal role in developing mutual trust which is a prerequisite of partnership building. Short-term hardships can willingly be accepted by a partner with the expectation that the other party will act in the same way. With this attitude of sharing benefits and burdens, both partners gain in the long run (Gardner *et al.*, 1994). In light of Hanjin's collapse, such distributive fairness is also a very important issue.

Given that higher quality and lower costs have been widely pointed out as the benefits of long-term relationships (Kalwani and Narayandas, 1995), long-term relationships between the SC members can be justified. Especially, on the weaker members' part, reinforcing long-term relationships with the superior members can be indispensable for their long-term survival. Long-term relationships with the dominant SC partners provide a stable foundation of long-term growth of the weaker members. In this regard, shippers should maintain and enhance their long-term relationship with shipping companies through such efforts as joint expansion of new markets and joint development of new business plans if possible.

One of the major barriers to establishing collaboration is a lack of trust (Daugherty *et al.*, 2006). Given that trust among the SC members can realise real gains, the weaker members should also develop and implement methods to foster trust from their influential SC partners. However, because building trust is not an easy task (Min *et al.*, 2005) and trust has to be earned over time (Daugherty *et al.*, 2006), shipping companies should prove continuously and with patience that their promises are kept and complicated expectations or needs of shippers are met in daily interactions.

In this sense, it is also very important for shipping companies to realise that "the paramount consideration is for the shipowner to empathise with the shipper and strive to become flexible and responsive to the shipper's needs on an innovative value-added basis in a competitive logistic global environment. The freight rate is not the only paramount factor" (Branch, 2007, p.3). Offering diversified services such as integrated logistics services could be an example of satisfying their SC partners' demand. "Shipping companies are attempting to develop the equivalent of brand loyalty" (Gwilliam, 1993, p.82) and should make such efforts continuously to appeal to their superior SC partners.

In the same vein, the maxim of Blau (1964) should be kept in the minds of shipping companies that if an action of a member (a shipping company) has a more valuable result to the other member (a shipper) of an exchange, the other member (a shipper) is more likely to implement the same action (cooperation and collaboration) again. Furthermore, the trust of shippers in their shipping companies can play the role of an inhibitor to the exertion of their relatively strong position (Min *et al.*, 2005).

8.2.4 Implications for policy (research objective six)

Power has traditionally been on the side of shippers in adversarial relationships between shippers and carriers (Fugate *et al.*, 2009). Inter-organisational cooperation can be demanded by powerful extra organisational forces such as government and third party organisations (Schermerhorn, 1975). Collective action such as public governance of an association or a government can be one method to enhance coordination in hinterland SC (Van Der Horst and De Langen, 2008). "Because shipping is concerned with international trade, it inevitably operates within a complicated pattern of agreements between shipping companies, understandings with shippers and the policies of governments" (Stopford, 2009, p.89).

These arguments can support the mediating roles of government. Government as well as the two parties also devise “order-preserving mechanisms” which can make the immediate parties maintain cooperation during their contract execution (Williamson, 2008).

Given the shortage of two-way communication between the SC members and the superior position of shippers, as a starting point, government should first form consultative groups comprised of stakeholders to foster a cooperative atmosphere. Voluntary committees to address commercial practices, capacity forecasting, and other methods to enhance collaborative relationships between shippers and carriers were organised by the Federal Maritime Commission in 2010 (Heaver, 2015).

If judged by the CCSIs according to vessel types, the organisation of a consultative group for liner shipping (which recorded the lowest CCSIs) seems to be urgent. Next, the constitution of the bodies should extend to bulk, tanker, and other sectors in due course.

In parallel with the setup of a consultative group, government should collate, provide and disseminate good practices of cooperation and collaboration to the parties concerned. This is because although collaboration has the advantages such as process efficiency, offering flexibility, business synergy, quality, and innovation (Cao *et al.*, 2009; Cao and Zhang, 2010; 2011), many firms do not adopt formal collaborative arrangements because of poor understanding of collaboration (Barratt, 2004; Ramanathan and Gunasekaran, 2014). The CCSIs indicate that maritime SCC is no exception to this case. Furthermore, in spite of the importance of such norms as mutuality, trust, commitment for collaboration, how to translate the intangible variables into operational processes is not an easy task and proper actions for execution should follow those attitudinal behaviours (Fugate *et al.*, 2009).

Given that “other vessels” have the highest CCSIs, “other vessels” consisting of tug and barge and reefer are expected to have a lot of good practices. Besides, considering that the contract period over 3 years comprises 43.9% of bulk and 39.3% of tanker respectively, collation of good practices may not be impossible in bulk and tanker shipping. Although container shipping has the lowest CCSIs, some good examples in which some shippers exert their cooperative attitudes towards shipping companies could be expected.

The focus for gathering good practices should include cases representative of good mutuality and sustainability. The best examples should involve how common plans are established, how performance can jointly be measured, and how assistance to overcome difficulties is given. The examples of “relationship extendedness” such as joint development of new business model and expanding new markets jointly also should be explored. Cases of long-term contract period having extremely close relationship with CCSIs should be collected.

The identification of good practices is expected to be able to provide any specific and desirable clues as to how to cooperate and collaborate with each other and further specific execution plans to enhance CCSIs between the SC members. Successful execution accomplished through the cooperative and collaborative efforts of shippers and shipping companies can assist logistics network design and strategic plans to generate mutual benefits (Stank and Goldsby, 2000).

To enhance CCSIs, government also should consider providing an institutional strategy to promote fairness, the key component of cooperation and the essential antecedent of trust. Under global competition and heightened uncertainties, government policies and regulatory regimes have encouraged new collaborative relationships among international logistics parties for improved efficiency (Heaver, 2015). Industrial constraints such as the limitation of the working hours of drivers from government lessen opportunistic tendencies by shippers and provoke more collaborative attitudes of shippers towards the inland carriers (Fugate *et al.*, 2009). These arguments and cases can justify the institutional consideration of government. Especially, a government should explore what methods can reinforce distribution fairness.

8.3 Limitations and recommendations

8.3.1 Limitations

The following limitations can be pointed out. First of all, shippers need to be classified in more detail to acquire a more exact understanding of the extent to which the superior SC members have cooperative and collaborative attitudes towards shipping companies. In this study, the CCSIs according to vessel types were achieved under the proposition that different types of vessels have their own differentiated shippers. Hence, the CCSIs by shippers could not be defined.

Second, although this study investigated that various contract periods can have different effects on the CCSIs according to vessel types, the reasons for the differences of CCSIs by vessel types need to be analysed in more detail. With regard to this limitation, it can be surmised that other comprehensive factors such as different characteristics of the main shippers as well as the contract period can affect the CCSIs by vessel types.

Finally, the specific identification and measurement of performance of cooperation and collaboration in the SC was not attempted in this study. Although performance is an issue which can sequentially be examined only after the existence of cooperative and collaborative relationships between the two SC members is confirmed, the empirical examination of performance would be conducive to revealing collaborative advantages.

8.3.2 Recommendations

The components of cooperation and collaboration were developed and adapted to identify the relationships among the components and to create the CCSIs. Through the CCSIs, the current state of cooperation and collaboration between the SC members was diagnosed, compared and evaluated. Albeit, the CCSIs should not be considered as a goal per se. The composite indicator should be regarded as an initial point for commencing discussion and drawing public interest (Nardo and Saisana, 2008). In this vein, some recommendations for future research are suggested as follows.

As discussed in Chapter Two, shippers in the SC can vary. The future research with the detailed categorisation of shippers such as suppliers, manufacturers, distributors, large retailers, freight forwarders, and others could make more accurate diagnoses and evaluations of CCSIs according to specified shippers possible.

It cannot be denied that different views from one side can be derived from the other side. Albeit, the views of only one side (shipping firms) were examined in this study. The potential for common methods variance can arise through the single informant design (Griffith *et al.*, 2006). The influential SC members also have opinions on how collaboratively they are treating their weaker SC partners and on the collaboration levels of shipping companies towards them. To alleviate the concern about the assessment by only shipping companies, future research needs to be conducted based on data from both sides.

With regard to application of this research model and CCSIs to other SC relationships, the model and CCSIs methods could also be implemented to test other relationships within SCs. The other relationships span links between shipping companies and terminal operating companies or inland transport providers, between freight forwarders or logistics providers and shippers, or further between all SC members. However, because each relationship involves distinctive features, when the model is applied, the caveat that the items in this model have to be carefully re-examined by relevant experts in the SC should be noted. For example, even though this research concluded that joint demand forecasts and joint inventory management cannot be applied to the relationship between shippers and shipping companies, those inter-firm cooperative and collaborative activities are likely to exist in other inter-firm relations within SCs such as suppliers and manufactures and manufactures and distributers.

In terms of the application of the CCSIs to other countries for the comparison among CCSIs of each country, this research model and the calculation methods of CCSIs can also be applied. However, items of this research should be closely re-examined as well. This is because social culture and law context are not the same across the countries. In this sense, the item related to law (shippers try to comply with the regulations related to business transactions such as standard form of contract and the laws related to fare trade) should be adapted with particular caution. Hence, further interviews targeting shipping experts of other countries may be a better option for developing common adaptable items across countries. If based on the same criteria, the differences of the CCSIs between countries can be estimated and it is expected that each country can also identify its strong and weak points and adopt proper measures to enhance its advantages and to remedy its shortcomings in the field of shipping.

Finally, in relation to performance of cooperation and collaboration, future study of the relationships between the CCSIs and the performance of cooperation and collaboration is strongly recommended.

8.4 Summary

This chapter explained how ROs in this research were achieved. Based on the findings of this research, the contributions to theories were described and implications for management and policy were proposed. The limitations of this research were also addressed and some recommendations for future research were made.

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Appendix 1 Compilation of 82 initial items and deletion of 36 items based on industrial experts' opinions

N	Items	ARID (%)	Reasons
1	Shippers would like to exchange relevant and timely information with our firm [IS1]	9	
~~2~~	~~Shippers provide any information which might help our firm [IS2]~~	55	U1 (expansive)
3	Shippers keep our firm informed about events or changes that may affect our firm [IS3]	27	
4	Shippers provide feedback on our delivery services [IS4]	27	
5	Shippers and our firm keep frequent contact on a regular basis [Co1]	9	
6	Many different channels to communicate between shippers and our firm exist [Co2]	18	
~~7~~	~~Shippers pay attention to our firm's comments [Co3]~~	18	U2 (expansive)
8	Communication between shippers and our firm is open and two-way [Co4]	18	
9	Cooperative and collaborative goals or objectives are settled by prior agreements with shippers [Fo1]	27	
10	Our firm arranges cooperative and collaborative implementation plans together with shippers [Fo2]	55	
~~11~~	~~Our firm develops performance metrics and the resulting incentive together with shippers [Fo3]~~	73	NA1
~~12~~	~~Our firm adjusts cooperative and collaborative schedules together with shippers [Fo4]~~	36	U3 (ambiguous)
~~13~~	~~Shippers train their employees through a code of conduct [CC1]~~	55	U4 (abstract)
~~14~~	~~We believe the employees of shippers observe well the code of conduct [CC2]~~	64	U5 (abstract)
~~15~~	~~Shippers take actions actively to promote a code of conduct [CC3]~~	45	U6 (abstract)
~~16~~	~~Shippers are willing to take responsibility for any damages resulting from their employees' misbehaviours [CC4]~~	73	NA2
17	Shippers do not discriminate our firm against other shipping companies [RP1]	36	
18	Shippers observe well the general regulations related to business transaction such as standard form of contract	27	

N	Items	ARID (%)	Reasons
	[RP2]		
19	Shippers observe well the laws related to fair trade such as the Fair Trade Act [RP3]	27	
20	Disputes between shippers and our firm are smoothly settled by the regulations or laws related to business transaction [RP4]	36	
~~21~~	~~Shippers try to guarantee incentives commensurate with our firm's investment and risk [IA1]~~	64	U7 (ambiguous)
22	Shippers try to guarantee reasonable profits for our firm [IA2]	36	
23	Shippers share any additional risks, burden, and costs related to delivery with our firm [IA3]	45	
~~24~~	~~Shippers share any additional rewards and benefits with our firm [IA4]~~	64	U8 (ambiguous)
25	Shippers agree on the importance of cooperation and collaboration with our firm [GC1]	18	
26	Shippers and our firm understand each other's goals, priorities, roles [GC2]	36	
27	Shippers and our firm understand each other's products, processes, and services [GC3]	27	
~~28~~	~~Shippers agree on the importance of improvements in the delivery [GC4]~~	18	U9 (ambiguous)
~~29~~	~~Shippers develop demand forecasts jointly with our firm [DS1]~~	73	NA3
~~30~~	~~Shippers share delivery plans and decide on optimal delivery quantity jointly with our firm [DS2]~~	73	NA4
~~31~~	~~Shippers manage inventory jointly with our firm [DS3]~~	82	NA5
32	Shippers decide on availability level of our facilities and equipment jointly with our firm [DS4]	9	
~~33~~	~~Shippers share their facilities and equipment with our firm [RS1]~~	82	NA6
~~34~~	~~Shippers share their knowledge, skill, and technology with our firm [RS2]~~	82	NA7
35	Shippers dedicate personnel to managing the relationship with our firm [RS3]	36	
~~36~~	~~Shippers invest in other resources to support the relationship with our firm [RS4]~~	91	NA8
~~37~~	~~Shippers try to resolve any conflicts jointly with our firm [JPS1]~~	45	U10 (expansive)
38	Shippers listen to our firm's difficulties and try to help our firm deal with the difficulties [JPS2]	45	

N	Items	ARID (%)	Reasons
~~39~~	~~Shippers and our firm are willing to operate alliance teams to solve problems jointly [JPS3]~~	91	NA9
40	Shippers try to improve the delivery quality jointly with our firm [JPS4]	64	
41	Shippers review the performance of our firm on a regular basis jointly with our firm [JPM1]	45	
42	Shippers measure the contribution of our firm jointly with our firm [JPM2]	45	
~~43~~	~~Shippers determine rewards according to the contribution jointly with our firm [JPM3]~~	82	NA10
~~44~~	~~Shippers continue to update key goals (targets) jointly with our firm [JPM4]~~	82	NA11
~~45~~	~~Shippers search and acquire new and relevant knowledge jointly with our firm [JKC1]~~	73	NA12
~~46~~	~~Shippers assimilate and apply relevant knowledge jointly with our firm [JKC2]~~	73	NA13
47	Shippers identify customer needs related to delivery jointly with our firm [JKC3]	36	
~~48~~	~~Shippers learn of the intentions and capabilities of competitors jointly with our firm [JKC4]~~	73	NA14
~~49~~	~~Our shippers are like a friend to us [Co'1]~~	82	NA15
~~50~~	~~We feel our shippers have been on our side [Co'2]~~	64	U11 (abstract)
~~51~~	~~We feel a sense of loyalty to our shippers [Co'3]~~	64	U12 (ambiguous)
52	We feel a bond with our shippers [Co'4]	36	
~~53~~	~~We believe our shippers do not mislead our firm [In1]~~	73	NA16
54	Our shippers always gives us honest information [In2]	45	
~~55~~	~~Even though our shippers give lame explanation, we are confident that our shippers are telling the truth [In3]~~	64	U13 (ambiguous)
~~56~~	~~Shippers are willing to give their sincere apologies for their dishonesty [In4]~~	64	U14 (ambiguous)
57	We rely on our shippers keeping their promises [De1]	27	
~~58~~	~~We rely on our shippers not taking advantage of our firm [De2]~~	27	U15 (ambiguous)
59	We rely on the attention and willingness of top management of our shippers to maintain a good relationships with	9	

N	Items	ARID (%)	Reasons
	our firm [De3]		
60	We rely on the attention and willingness of working group of our shippers to maintain a good relationship with our firm [De4]	9	
~~61~~	~~We believe that our shippers can carry out important projects related to our activities [Co''1]~~	36	I1
~~62~~	~~We believe that our shippers fulfil their business obligations [Co''2]~~	45	U16 (ambiguous)
~~63~~	~~We believe that our shippers can do things which we cannot do [Co''3]~~	45	I2
~~64~~	~~We believe that our shippers hold successful reputations in their fields [Co''4]~~	18	I3
65	We feel happy that we can work with our shippers [Sa1]	36	
66	We feel that we benefit from the relationship with our shippers [Sa2]	0	
~~67~~	~~We feel that our firm is important to our shippers [Sa3]~~	18	U17 (ambiguous)
68	We feel that our shippers are satisfying the needs of our firm [Sa4]	0	
69	We believe our relationship with our shippers is strong and stable [LTR1]	36	
70	We expect our relationship with our shippers to last for a long time [LTR2]	18	
71	We expect the relationship with our shippers to strengthen over time [LTR3]	18	
72	The shippers regard our relationship as a long-term alliance [LTR4]	9	
73	We have experienced and expect the expansion of business with the help of our shippers [BE1]	9	
74	Shippers discover new markets jointly with our firm [BE2]	36	
75	Shippers share new business plans or ideas with our firm [BE3]	27	
76	Shippers try to expand overseas jointly with our firm [BE4]	45	
77	Our contracts with shippers have many unfavourable clauses [IP1]	27	
78	Shippers request unreasonable delivery price deduction and additional service demand [IP2]	36	

N	Items	ARID (%)	Reasons
79	Shippers tend to show failure or delay or reduction of contract payment [IP3]	27	
80	We have suffered defamation of character or unilateral pressure from shippers [BCC1]	36	
81	We have suffered illegal or unreasonable requests like bribery, treat, and convenience from shippers [BCC2]	36	
82	We have experienced retaliation caused by refusal of illegal or unreasonable requests from shippers [BCC3]	36	

ARID: Agreement rate of item deletion (rounded up and down to a unit), NA: Non-applicable to shipping industry
I: Irrelevant to the intent of this research, U: Unclear caused by expansive, abstract and ambiguous

Appendix 2 Twenty five items selected through deletion of redundant and overlapping items among remaining 46 items

N	Items	NN	Reasons of deletion
1	Shippers would like to exchange relevant and timely information with our firm	1	
~~3~~	~~Shippers keep our firm informed about events or changes that may affect our firm~~		R1 (a subset of [NN1])
4	~~Shippers provide feedback on our delivery services~~		R2 (a subset of [NN1])
~~5~~	~~Shippers and our firm keep frequent contact on a regular basis~~		M1 (overlapping with 6) into [NN2]
~~6~~	~~Many different channels to communicate between shippers and our firm exist~~		M2 (overlapping with 5) into [NN2]
	Shippers keep in frequent contact with our firm through various channels	2	
8	Communication between shippers and our firm is open and two-way	3	
~~9~~	~~Cooperative and collaborative goals or objectives are settled by prior agreements with shippers~~		M3 (overlapping with 10]) into [NN4]
~~10~~	~~Our firm arranges cooperative and collaborative implementation plans together with shippers~~		M4 (overlapping with 9) into [NN4]
	Shippers settle cooperative and collaborative implementation plans or objectives by prior agreements with our firm	4	
17	Shippers do not discriminate our firm against other shipping companies	5	
~~18~~	~~Shippers observe well the general regulations related to business transaction such as standard form of contract~~		M5 (overlapping with 19) into [NN6]
~~19~~	~~Shippers observe well the laws related to fair trade such as the Fair Trade Act~~		M6 (overlapping with 18) into [NN6]
	Shippers observe well the general regulations related to business transactions such as standard form of contract and the laws related to fair trade such as the Fair Trade Act	6	
~~20~~	~~Disputes between shippers and our firm are smoothly settled by the regulations or laws related to business transaction~~		R3 (a subset of [NN6])
22	Shippers try to guarantee reasonable profits for our firm	7	
23	Shippers share any additional risks, burden, and costs related to delivery with our firm	8	
~~25~~	~~Shippers agree on the importance of cooperation and collaboration with our firm~~		M7 (overlapping with 27) into [NN9]
~~26~~	~~Shippers and our firm understand each other's goals, priorities, roles~~		R4 (a subset of 27)
~~27~~	~~Shippers and our firm understand each other's products, processes, and services~~		M8 (overlapping with 25) into [NN9]

N	Items	NN	Reasons of deletion
	Shippers agree on the importance of cooperation and collaboration with our firm and shippers and our firm both understand each other’s products, processes and services well	9	
32	Shippers decide on availability level of our facilities and equipment jointly with our firm	10	
35	Shippers dedicate personnel to managing the relationship with our firm	11	
38	Shippers listen to our firm’s difficulties and try to help our firm deal with the difficulties	12	
~~40~~	~~Shippers try to improve the delivery quality jointly with our firm~~		M9 (overlapping with 47) into [NN14]
41	Shippers review the performance of our firm on a regular basis jointly with our firm	13	
~~42~~	~~Shippers measure the contribution of our firm jointly with our firm~~		R5 (a subset of [NN13])
	Shippers identify customer needs related to delivery and try to improve the delivery quality jointly with our firm	14	
~~47~~	~~Shippers identify customer needs related to delivery jointly with our firm~~		M10 (overlapping with 40) into [NN14]
52	We feel a bond with our shippers	15	
~~54~~	~~Our shippers always gives us honest information~~		R6 (a subset of [NN16], [NN1])
~~57~~	~~We rely on our shippers keeping their promises~~		R7 (a subset of 62)
~~59~~	~~We rely on the attention and willingness of top management of our shippers to maintain a good relationships with our firm~~		M11 (overlapping with 60) into [NN16]
~~60~~	~~We rely on the attention and willingness of working group of our shippers to maintain a good relationship with our firm~~		M12 (overlapping with 59) into [NN16]
	We rely on the attention and willingness of shippers to maintain a good relationship with our firm	16	
~~65~~	~~We feel happy that we can work with our shippers~~		M13 (overlapping with 68) into [NN17]
~~66~~	~~We feel that we benefit from the relationship with our shippers~~		M14 (overlapping with 68) into [NN17]
	We benefit from and are satisfied with the relationship with shippers	17	
~~68~~	~~We feel that our shippers are satisfying the needs of our firm~~		M15 (overlapping with 65, 66) into [NN17]
~~69~~	~~We believe our relationship with our shippers is strong and stable~~		M16 (overlapping with 70) into [NN18]
~~70~~	~~We expect our relationship with our shippers to last for a long time~~		M17 (overlapping with 69) into [NN18]
	We believe the relationship with shippers is stable	18	
71	We believe the relationship with shippers will last for a long time and strengthen over time	19	
~~72~~	~~The shippers regard our relationship as a long-term alliance~~		R8 (similar meaning with [NN18])
73	We have experienced the expansion of business with the help of our shippers	20	

N	Items	NN	Reasons of deletion
~~74~~	~~Shippers discover new markets jointly with our firm~~		M18 (overlapping 75, 76) into [NN21]
	Shippers try to share new business plans or ideas and expand new markets (including foreign market) jointly with our firm	21	
~~75~~	~~Shippers share new business plans or ideas with our firm~~		M19 (overlapping with 74) into [NN21]
~~76~~	~~Shippers try to expand overseas jointly with our firm~~		M20 (overlapping with 74) into [NN21]
77	Our contracts with shippers have many unfavourable clauses	22	
~~78~~	~~Shippers request unreasonable delivery price deduction and additional service demand~~		M21 (overlapping with 79) into [NN23]
~~79~~	~~Shippers tend to show failure or delay or reduction of contract payment~~		M22 (overlapping with 78) into [NN23]
	Shippers tend to request unreasonable delivery price deduction (including failure and delay of the payment) or additional service demand [IP4] 10	23	
~~80~~	~~We have suffered defamation of character or unilateral pressure from shippers~~		M23 (overlapping with 81) into [NN24]
~~81~~	~~We have suffered illegal or unreasonable requests like bribery, treat, and convenience from shippers~~		M24 (overlapping with 80) into [NN24]
	We have suffered defamation of character or illegal and unreasonable requests such as bribery, lavish entertainment and preferential treatment	24	
82	We have experienced retaliation caused by refusal of illegal or unreasonable requests from shippers	25	

N: Incipient item number
NN: New number of items
R: Redundant (unnecessary because of similar or the same meaning with or a subset of an item)
M: Merged (because of overlapping with an item)

Appendix 3 Twenty eight items for Q-sorting including revised items 33, 36 and 62

IN	NN	Items
1	1	Shippers would like to exchange relevant and timely information with our firm
	2	Shippers would like to keep in frequent contact with our firm through various channels
8	3	Shippers would like to make communication with our firm open and two-way
	4	Shippers would like to settle cooperative and collaborative implementation plans or objectives by prior agreements with our firm
17	5	Shippers try not to discriminate our firm against other shipping companies
	6	Shippers try to observe well the general regulations related to business transactions such as standard form of contract and the laws related to fair trade such as the Fair Trade Act
22	7	Shippers make an effort to guarantee reasonable profits for our firm
23	8	Shippers make an effort to share any additional risks, burden, and costs related to delivery with our firm
	9	Shippers agree on the importance of cooperation and collaboration with our firm and shippers are willing to understand our firm's services well
32	10	Shippers are willing to decide on availability level of our facilities and equipment jointly with our firm
33	11	Shippers are willing to share their facilities and equipment such as their dock, cranes, delivery vehicles with our firm (if shippers have such facilities and equipment)
35	12	Shippers are willing to dedicate personnel to managing the relationship with our firm
36	13	Shippers are willing to provide financial support such as guarantee of a bank loan required for procurement of vessels of our firm (if shippers have such financial capabilities)
38	14	Shippers are willing to listen to our firm's difficulties and to help our firm deal with the difficulties
41	15	Shippers are willing to review the performance of our firm on a regular basis jointly with our firm
	16	Shippers are willing to identify customer needs related to delivery and to improve the delivery quality jointly with our firm
52	17	We feel a bond with our shippers
	18	We rely on the attention and willingness of shippers to maintain a good relationship with our firm
62	19	We believe that shippers fulfil their contractual obligations
	20	We benefit from and are satisfied with the relationship with shippers
	21	We believe the relationship with shippers is stable
71	22	We believe the relationship with shippers will last for a long time and strengthen over time
73	23	We have experienced the expansion of business with the help of our shippers
	24	Shippers try to share new business plans or ideas and to expand new markets (including foreign market) jointly with our firm
77	25	Our contracts with shippers have many unfavourable clauses
	26	Shippers tend to request unreasonable delivery price deduction (including failure and delay of contract payment) or additional service demand
	27	We have suffered defamation of character or illegal and unreasonable requests such as bribery, lavish entertainment and preferential treatment from

IN	NN	Items
		shippers
82	28	We have experienced retaliation caused by refusal of illegal or unreasonable requests from shippers

Appendix 4 Outcome of the first round Q-sorting

Constructs (6)	N	Items	Agreement rate (%)
Transparency (4)	1	Shippers would like to exchange relevant and timely information with our firm	70
	2	Shippers would like to keep in frequent contact with our firm through various channels	25
	3	Shippers would like to make communication with our firm open and two-way	75
	4	Shippers would like to settle cooperative and collaborative implementation plans or objectives by prior agreements with our firm	10
Fairness (4)	5	Shippers try not to discriminate our firm against other shipping companies	85
	6	Shippers try to observe well the general regulations related to business transactions such as standard form of contract and the laws related to fair trade such as the Fair Trade Act	60
	7	Shippers make an effort to guarantee reasonable profits for our firm	50
	8	Shippers make an effort to share any additional risks, burden, and costs related to delivery with our firm	55
Mutuality (8)	9	Shippers agree on the importance of cooperation and collaboration with our firm and shippers are willing to understand our firm’s services well	55
	10	Shippers are willing to decide on availability level of our facilities and equipment jointly with our firm	75
	11	Shippers are willing to share their facilities and equipment such as their dock, cranes, delivery vehicles with our firm (if shippers have such facilities and equipment)	50
	12	Shippers are willing to dedicate personnel to managing the relationship with our firm	15
	13	Shippers are willing to provide financial support such as guarantee of a bank loan required for procurement of vessels of our firm (if shippers have such financial capabilities)	10
	14	Shippers are willing to listen to our firm’s difficulties and to help our firm deal with the difficulties	20
	15	Shippers are willing to review the performance of our firm on a regular basis jointly with our firm	45
	16	Shippers are willing to identify customer needs related to delivery and to improve the delivery quality jointly with our firm	50
Trust (4)	17	We feel a bond with our shippers	60
	18	We rely on the attention and willingness of shippers to maintain a good relationship with our firm	45
	19	We believe that shippers fulfil their contractual obligations	90
	20	We benefit from and are satisfied with the relationship with shippers	5
Sustainability (4)	21	We believe the relationship with shippers is stable	70
	22	We believe the relationship with shippers will last for a long time and strengthen over time	55
	23	We have experienced the expansion of business with the help of shippers	25
	24	Shippers try to share new business plans or ideas and expand new markets (including foreign market) jointly with our firm	25
Power	25	Our contracts with shippers have many unfavourable clauses	100

Constructs (6)	N	Items	Agreement rate (%)
(4)	26	Shippers tend to request unreasonable delivery price deduction (including failure and delay of contract payment) or additional service demand	90
	27	We have suffered defamation of character or illegal and unreasonable requests such as bribery, lavish entertainment and preferential treatment	100
	28	We have experienced retaliation caused by refusal of illegal or unreasonable requests from shippers	95

Appendix 5 Comparison between initial and revised constructs and items after the first round Q-sorting

The first round Q-sorting			Remarks	Revised constructs and items		
Constructs (6)	IN	Items		Constructs(6)	NN	Items
Transparency (4)	1	Shippers would like to exchange relevant and timely information with our firm	Revised into NN1 to be more clear	Transparency (4)	1	Shippers exchange relevant and timely information with our firm
	2	Shippers would like to keep in frequent contact with our firm through various channels	LAR (confused with sustainability) and Unclear → Revised into NN2 to be more clear		2	Shippers and our firm communicate smoothly with each other through various channels
	3	Shippers would like to make communication with our firm open and two-way	Revised into NN3 to be more clear		3	Shippers make communication with our firm open and two-way
	4	Shippers would like to settle cooperative and collaborative implementation plans or objectives by prior agreements with our firm	LAR (confused with equal footing) and Unclear → Separated into NN4, NN13 to be more clear		4	The cooperative and collaborative relationship between shippers and our firm is understood clearly and transparently through prior agreements
Fairness (4)	5	Shippers try not to discriminate our firm against other shipping companies	Revised into NN5 to be more clear	Fairness (4)	5	Shippers do not discriminate our firm against other shipping companies
	6	Shippers try to observe well the general regulations related to business transactions such as standard form of contract and the laws related to fair trade such as the Fair Trade Act	Revised into NN6 to be more clear		6	Shippers try to comply with the regulations related to business transactions such as standard form of contract and the laws related to fair trade such as the Fair Trade Act for fair trade with our firm

The first round Q-sorting			Remarks	Revised constructs and items		
Constructs (6)	IN	Items		Constructs(6)	NN	Items
	7	Shippers make an effort to guarantee reasonable profits for our firm	LAR and unclear → Revised into NN7 to be more clear		7	Shippers make an effort to guarantee reasonable and just profits for our firm
	8	Shippers make an effort to share any additional risks, burden, and costs related to delivery with our firm	Revised into NN8 to be more clear		8	Shippers make an effort to bear reasonably and justly any additional risks, burden, and costs related to delivery with our firm
Mutuality (8)	9	Shippers agree on the importance of cooperation and collaboration with our firm and shippers are willing to understand our firm's services well	Unclear → Revised into NN9 to be more clear	Mutuality (8)	9	Overall, shippers understand our firm's services well and are willing to provide any necessary assistance
	10	Shippers are willing to decide on availability level of our facilities and equipment jointly with our firm	Revised into NN14 to be more clear		10	Shippers are willing to provide their facilities and equipment such as their dock, cranes, delivery vehicles with our firm (if shippers have such facilities and equipment)
	11	Shippers are willing to share their facilities and equipment such as their dock, cranes, delivery vehicles with our firm (if shippers have such facilities and equipment)	LAR and unclear → Revised into NN10 to be clear		11	Shippers are willing to provide financial support such as guarantee of a bank loan required for procurement of vessels for our firm (if shippers have such financial capabilities)
	12	Shippers are willing to dedicate personnel to managing the relationship with our firm	LAR (not-applicable, confused with sustainability) and unclear → Deleted		12	Shippers are willing to assist our firm in overcoming the difficulties when our firm is faced with any difficulties
	13	Shippers are willing to provide financial support such as guarantee of a bank loan required for procurement of vessels of our firm (if shippers have such	LAR (confused with trust) but no change, NN11		13	Shippers and our firm, as equal business partners, settle together common cooperative and collaborative implementation plans or objectives

The first round Q-sorting			Remarks	Revised constructs and items		
Constructs (6)	IN	Items		Constructs(6)	NN	Items
		financial capabilities)				
	14	Shippers are willing to listen to our firm's difficulties and to help our firm deal with the difficulties	LAR (confused with sustainability) and unclear → Revised into NN12 to be clear		14	Shippers and our firm, as equal business partners, decide together on availability level of our facilities and equipment
	15	Shippers are willing to review the performance of our firm on a regular basis jointly with our firm	LAR and unclear → Revised into NN16 to be more clear		15	Shippers and our firm, as equal business partners, identify together customer needs related to delivery and try to improve the delivery quality jointly
	16	Shippers are willing to identify customer needs related to delivery and to improve the delivery quality jointly with our firm	LAR and unclear → Revised into NN 15 to be more clear		16	Shippers and our firm, as equal business partners, review together the performance of our firm
Trust (4)	17	We feel a bond with our shippers	Abstract and unclear → Deleted and replaced by NN17	Trust (4)	17	Overall, shippers are trustworthy
	18	We rely on the attention and willingness of shippers to maintain a good relationship with our firm	LAR (confused with sustainability) and unclear → Revised into NN18 to be more clear		18	We believe the good faith of shippers when it comes to the relationship between shippers and our firm
	19	We believe that shippers fulfil their contractual obligations	No change, NN19		19	We believe that shippers fulfil their contractual obligations
	20	We benefit from and are satisfied with the relationship with shippers	LAR (confused with sustainability) and unclear → Revised into NN20 to be more clear		20	We believe that shippers benefit our firm
Sustainability	21	We believe the relationship with	Revised into NN21 to	Sustainability	21	The relationship between shippers and

The first round Q-sorting			Remarks	Revised constructs and items		
Constructs (6)	IN	Items		Constructs(6)	NN	Items
(4)		shippers is stable	be more clear	(4)		our firm is stable
	22	We believe the relationship with shippers will last for a long time and strengthen over time	Revised into NN22 to be more clear		22	The relationship between shippers and our firm will last and strengthen over time
	23	We have experienced the expansion of business with the help of shippers	LAR(not-applicable) and unclear → Deleted		23	Shippers try to maintain their relationship with our firm such as developing together new business plans or ideas
	24	Shippers try to share new business plans or ideas and expand new markets (including foreign market) jointly with our firm	LAR (confused with equal footing) and unclear → Divided into NN23, 24 to be more clear		24	Shippers try to enhance continuously their relationship with our firm such as expanding jointly new markets (including foreign markets)
Power (4)	25	Our contracts with shippers have many unfavourable clauses	No change, NN25	Power (4)	25	Our contracts with shippers have many unfavourable clauses
	26	Shippers tend to request unreasonable delivery price deduction (including failure and delay of contract payment) or additional service demand	No change, NN26		26	Shippers tend to request unreasonable delivery price deduction (including failure and delay of contract payment) or additional service demand
	27	We have suffered defamation of character or illegal and unreasonable requests such as bribery, lavish entertainment and preferential treatment	No change, NN27		27	We have suffered defamation of character or illegal and unreasonable requests such as bribery, lavish entertainment and preferential treatment
	28	We have experienced retaliation caused by refusal of illegal or unreasonable requests from shippers	No change, NN28		28	We have experienced retaliation caused by refusal of illegal or unreasonable requests from shippers

Note. IN: Initial number of an item, NN: New number of an item, LAR: Low Agreement Rate (Less than 50%)

Appendix 6 Revised items for the second round Q-sorting

Constructs (6)	NN	QN	Items
Transparency (4)	1	5	Shippers exchange relevant and timely information with our firm
	2	14	Shippers and our firm communicate smoothly with each other through various channels
	3	20	Shippers make communication with our firm open and two-way
	4	27	The cooperative and collaborative relationship between shippers and our firm is understood clearly and transparently by prior agreements
Fairness (4)	5	1	Shippers do not discriminate our firm against other shipping companies
	6	8	Shippers try to observe well the regulations related to business transactions such as standard form of contract and the laws related to fair trade such as the Fair Trade Act for the fair trade with our firm
	7	15	Shippers make an effort to guarantee reasonable and just profits for our firm
	8	21	Shippers make an effort to bear reasonably and justly any additional risks, burden, and costs related to delivery with our firm
Mutuality (8)	9	7	Overall, shippers understand our firm’s services well and are willing to provide any necessary assistance
	10	16	Shippers are willing to provide their facilities and equipment such as their dock, cranes, delivery vehicles with our firm (if shippers have such facilities and equipment)
	11	11	Shippers are willing to provide financial support such as guarantee of a bank loan required for procurement of vessels of our firm (if shippers have such financial capabilities)
	12	25	Shippers are willing to assist our firm with overcoming the difficulties when our firm is faced with any difficulties
	13	22	Shippers and our firm, as even business partners, settle together common cooperative and collaborative implementation plans or objectives
	14	9	Shippers and our firm, as even business partners, decide together on availability level of our facilities and equipment
	15	4	Shippers and our firm, as even business partners, identify together customer needs related to delivery and try to improve the delivery quality jointly
	16	28	Shippers and our firm, as even business partners, review together the performance of our firm
Trust (4)	17	3	Overall, shippers are trustworthy
	18	10	We believe the good faith of shippers when it comes to the relationship between shippers and our firm
	19	17	We believe that shippers fulfil their contractual obligations

Constructs (6)	NN	QN	Items
	20	23	We believe that shippers benefit our firm
Sustainability (4)	21	2	The relationship between shippers and our firm is stable
	22	12	The relationship between shippers and our firm will last and strengthen over time
	23	18	Shippers try to maintain their relationship with our firm such as developing together new business plans or ideas
	24	24	Shippers try to enhance continuously their relationship with our firm such as expanding jointly new markets (including foreign market)
Power (4)	25	6	Our contracts with shippers have many unfavourable clauses
	26	13	Shippers tend to request unreasonable delivery price deduction (including failure and delay of contract payment) or additional service demand
	27	19	We have suffered defamation of character or illegal and unreasonable requests such as bribery, lavish entertainment and preferential treatment
	28	26	We have experienced retaliation caused by refusal of illegal or unreasonable requests from shippers

NN: New number of an item
QN: Q-sorting number of an item

Appendix 7 Pilot questionnaire

INTERNATIONAL SHIPPING AND LOGISTICS WITH PLYMOUTH UNIVERSITY

Mr. Chang Soo Kim, PhD Researcher
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30 May 2016

Re: **Pilot Test of Logistics and Supply Chain Cooperative and Collaborative Spirit Indices in South Korea**

Dear

As an expert, please could you spare a few moments to answer and comment on the following questions. As a PhD researcher in Plymouth Graduate School of Management (www.plymouth.ac.uk/schools/plymouth-business-school), my research aims to develop a cooperative and collaborative spirit index between shipping companies and shippers within South Korea as a case study of collaboration in supply chains. I am researching the extent to which shippers have cooperative and collaborative attitudes towards shipping companies in the logistics chain from the stance of shipping companies.

On page 3 is a draft questionnaire based on the opinions of public officials, staff members of associations and survey institutes, professors and industrial experts engaged in supply chains in South Korea.

1. How long did it take to complete the draft questionnaire? (   )minutes

2. Please highlight any unclear or ambiguous instructions in the draft questionnaire and say why they are unclear.
   (   )

3. Please highlight any unclear or ambiguous statements in the draft questionnaire and say why they are unclear.
   (   )

4. Based on the types of vessels registered in South Korea, the draft questionnaire classifies the types of vessels into ① container ship, ② bulk carrier (including grain, ore, coal, cement, timber, steel product, car) ③ crude oil tanker ④ LPG/LNG tanker ⑤ product /chemical carrier, ⑥ general cargo vessel ⑦ tug and barge ⑧ others (such as a refrigerated vessel).

In your opinion what is the best way to reduce the number of the types of vessels considering the similarity of shippers?

(   )

※ *For example, the shippers who deal with ③ crude oil, ④ LPG/LNG and ⑤ product/chemical are nearly same as each other. Therefore, it is better to merge ③ crude oil tanker ④ LPG/LNG tanker and ⑤ product /chemical carrier into a new category, ③ vessel related to oil, which results in total six types of vessels*

5. If you have any other issues to mention about the draft questionnaire, please use space below.

(   )

INTERNATIONAL SHIPPING AND LOGISTICS WITH PLYMOUTH UNIVERSITY

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Logistics and supply chain cooperative and collaborative spirit indices in South Korea

Dear

As an expert, please could you spare a few moments to answer the following questions. As a PhD researcher in Plymouth Graduate School of Management (www.plymouth.ac.uk/schools/plymouth-business-school), my research aims to develop a cooperative and collaborative spirit index between shipping companies and shippers within South Korea as a case study of collaboration in supply chains. I am researching the extent to which shippers have cooperative and collaborative attitudes towards shipping companies in logistics chains from the stance of shipping companies.

It is generally considered that South Korea has a favourable environment within which to grow its shipping industry in that the country borders the ocean in three directions and has many global shippers such as Samsung, LG, POSCO, Hyundai, SK innovation. However, the shipping industry of South Korea has had a difficult time with excess supply of shipping space caused by the emergence of larger ships and reduction of demand led by slow recovery of the world economy since the 2008 financial crisis.

Since the turnover of shipping companies depends on business transactions with shippers, a cooperative and collaborative relationship between shipping companies and shippers in supply chains is essential. Therefore, a cooperative and collaborative spirit between shipping companies and shippers underpins stable and sustainable growth of shipping companies within supply chains. The cordial exertion of a cooperative and collaborative spirit of a shipper towards a shipping company, as a confident partner, may be conducive to overcoming difficulties which the shipping industry faces.

Based on this survey, cooperative and collaborative indices of ocean-going shipping and coastal shipping as well as container and bulk sectors will be computed to identify how the relationship between shipping companies and shippers can be improved.

Any information you offer will be used only for academic purposes and all information about shipping companies will be treated in the strictest confidence.

If you have any questions about this survey, please contact me. If you would like to receive an executive summary of my findings, please enter your email address in ninth question in section D.

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Draft Questionnaire

SECTION A	Instructions

1. The questionnaire is comprised of three sections.
   - Section B provides six constructs which were identified to describe a cooperative and collaborative spirit between shipping companies and shippers.
   - Section C suggests 28 statements to measure the six constructs. Four or eight statements per construct are offered and you are asked for your opinion of each statement on a seven-point rating scale comprising 'Strongly disagree', 'Disagree', 'Slightly disagree', 'Neutral', 'Slightly agree', 'Agree', 'Strongly agree'.
   - Section D consists of nine questions related to your profile such as where a shipping company is registered, whether it is engaged in ocean-going shipping or coastal shipping, and shipping space which a shipping company is holding.

2. If your shipping company has no business transaction with shippers in South Korea, please do not respond.

3. If your shipping company is registered to manage both ocean-going shipping and coastal shipping in South Korea, please fill in two separate questionnaires: one in the positon of a shipping company registered in ocean-going shipping and the other in the position of the company registered in costal shipping.

4. This questionnaire classifies vessels into the following eight types based on the types of vessels registered in South Korea:
   - Container ship,
   - Bulk carrier (including grain, ore, coal, cement, timber, steel product, car)
   - Crude oil tanker
   - LPG/LNG tanker
   - Product /chemical carrier,
   - General cargo vessel
   - Tug and barge
   - Others (such as a refrigerated vessel)

   If your shipping company is registering several types of vessels in South Korea, please fill in the same number of copies of questionnaires as the number of the types. This is because different shippers may exist according to different types of vessels.

   ※ For example, if your shipping company has four types of vessels such as bulk carrier, crude oil tanker, LPG tanker, and chemical carrier, please fill in separately a copy of questionnaire for each type of vessel (the same four copies of questionnaires as four types of the registered vessels).

SECTION B	The explanation of the constructs

◈ This research identified six constructs (including a construct having a negative meaning) which are shown below. These represent the cooperative and collaborative spirit of shippers as previously described in the academic literature. The table below also includes broad definitions about the six constructs. After reading the broad definitions, please answer the statements on the next pages.

Construct	Broad Definition
1. Transparency	The extent to which shippers have an open and transparent relationship with shipping companies such as smooth communication, information sharing, and clear setting-up of the relationship through prior agreement
2. Fairness	The extent to which shippers treat shipping companies fairly and justly such as no discrimination between shipping companies, observation of related regulations and laws, and guarantee of reasonable and just profits for shipping companies
3. Mutuality	The extent to which shippers treat shipping companies as an equal business partner such as joint settling of business plans or objectives, joint endeavours to improve the business and joint performance review and are willing to support shipping companies such as understanding their shipping service and offering material or financial assistance
4. Trust	The extent to which shippers can be trusted such as good faith, fulfilment of contractual obligations, and providing benefits
5. Sustainability	The extent to which shippers sustain and strengthen continuously their relationship with shipping companies such as joint development of new business plans and joint expansion to new markets
6. Power	The extent to which shippers exert their superior power towards shipping companies

SECTION C	Text of the questionnaire

※ After reading the following statements, please insert "X" in the column under the number that you think match your view most closely.

※ 1=Strongly disagree, 2=Disagree, 3=Slightly disagree, 4=Neutral, 5=Slightly agree, 6=Agree, 7=Strongly agree

C-1	**Transparency**: This section measures the extent to which shippers have an open and transparent relationship with shipping companies	← Disagree						Agree →
		1	2	3	4	5	6	7
1	Shippers exchange relevant and timely information with our firm							
2	Shippers and our firm communicate smoothly with each other through various channels such as regular or casual meeting between executives or between staffs							
3	Shippers make communication with our firm open and two-way							
4	The cooperative and collaborative relationship between shippers and our firm is understood clearly and transparently through prior agreements							

C-2	**Fairness**: This section measures the extent to which shippers treat shipping companies fairly and justly	← Disagree						Agree →
		1	2	3	4	5	6	7
5	Shippers do not discriminate our firm against other shipping companies							
6	Shippers try to comply with the regulations related to business transactions such as standard form of contract and the laws related to fair trade such as the Fair Trade Act							
7	Shippers make an effort to guarantee reasonable and just profits for our firm							
8	Shippers make an effort to bear reasonably and justly any additional risks, burden, and costs related to delivery with our firm							

※ 1=Strongly disagree, 2=Disagree, 3=Slightly disagree, 4=Neutral, 5=Slightly agree, 6=Agree, 7=Strongly agree

C-3	**Mutuality**: This section measures the extent to which shippers are willing to support shipping companies and treat shipping companies as an equal business partner	← Disagree						Agree →
		1	2	3	4	5	6	7
9	Overall, shippers understand our firm's services well and are willing to provide any necessary assistance							
10	Shippers are willing to provide their facilities and equipment such as their dock, cranes, delivery vehicles with our firm (if shippers have such facilities and equipment)							
11	Shippers are willing to provide financial support such as guarantee of a bank loan required for procurement of vessels for our firm (if shippers have such financial capabilities)							
12	Shippers are willing to assist our firm in overcoming the difficulties when our firm is faced with any difficulties							
13	Shippers and our firm, as equal business partners, settle together common cooperative and collaborative implementation plans or objectives							
14	Shippers and our firm, as equal business partners, decide together the availability level of our facilities and equipment							
15	Shippers and our firm, as equal business partners, identify together customer needs related to delivery and try to improve the delivery quality jointly							
16	Shippers and our firm, as equal business partners, review together the performance of our firm							

※ 1=Strongly disagree, 2=Disagree, 3=Slightly disagree, 4=Neutral, 5=Slightly agree, 6=Agree, 7=Strongly agree

C-4	**Trust**: This section measures the extent to which shippers can be trusted	← Disagree						Agree →
		1	2	3	4	5	6	7
17	Overall, shippers are trustworthy							
18	We believe the good faith of shippers when it comes to the relationship between shippers and our firm							
19	We believe that shippers fulfil their contractual obligations							
20	We believe that shippers benefit our firm							

C-5	**Sustainability**: This section measures the extent to which shippers sustain and strengthen continuously their relationship with shipping companies	← Disagree						Agree →
		1	2	3	4	5	6	7
21	The relationship between shippers and our firm is stable							
22	The relationship between shippers and our firm will last and strengthen over time							
23	Shippers try to maintain their relationship with our firm such as developing together new business plans or ideas							
24	Shippers try to enhance continuously their relationship with our firm such as expanding jointly new markets (including foreign markets)							

C-6	**Power**: This section measures the extent to which shippers exert their superior power towards shipping companies	← Disagree						Agree →
		1	2	3	4	5	6	7
25	Our contracts with shippers have many unfavourable clauses							
26	Shippers tend to request unreasonable delivery price deduction (including failure and delay of contract payment) or additional service demand							
27	We have suffered defamation of character or illegal and unreasonable requests such as bribery, lavish entertainment and preferential treatment							
28	We have experienced retaliation caused by refusal of illegal or unreasonable requests from shippers							

SECTION D	The respondent profile

※ Please answer the questions shown.

1. Please tick one box to show which type of shipping your company is registered for.

※ ***Please, select only one answer here*** *(If your company is registered in both ocean-going shipping and coastal shipping, please fill in two copies of this questionnaire)*

① Coastal shipping ☐ ② Ocean-going shipping ☐

2. Please tick one box to select one type of vessel which your company operates.

※ ***Please, select only one answer here*** *(If your company has several types of vessels, please fill in the same number of copies of questionnaires as the number of the types of vessels)*

① Container ship	☐	② Bulk carrier (including grain, ore, coal, cement, timber*, steel product*, car*)	☐	③ Crude oil tanker	☐	④ LPG/LNG tanker	☐
⑤ Product/ chemical carrier	☐	⑥ General cargo vessel	☐	⑦ Tug and barge	☐	⑧ Others** please specify (　　)	☐

* Can be included in neo bulk
** Such as a refrigerated vessel

If you are not answering as a bulk carrier, please go to question 3

2-1. As a bulk carrier, please tick one box to indicate your primary cargo.

① Grain	☐	② Ore	☐	③ Coal	☐	④ Cement	☐
⑤ Timber	☐	⑥ Steel product	☐	⑦ Car	☐	⑧ Others please specify (　　)	☐

3. How many vessels does your company operate in this sector? (　　)

And what is the total sum of gross registered tonnage of the vessels? (　　) GRT

※ Please fill in gross registered tonnage including chartered vessels

4. Please tick one box to show how many permanent employees (including seafarers) your company employs in total.

① Fewer than 10	☐	② 10~49	☐	③ 50~99	☐	④ 100~149	☐
⑤ 150~199	☐	⑥ 200~249	☐	⑦ 250~299	☐	⑧ More than 300	☐

5. Please tick one box to show what your current positon is in your company.

① Staff	☐	② Assistant Manager	☐	③ Manager	☐	④ Deputy Department Manager	☐
⑤ Department Manager	☐	⑥ Director/ Senior Director	☐	⑦ CEO	☐		

6. Please tick one box to show how long you have been engaged in the shipping industry.

① less than five years	☐	② five~nine years	☐	⁾ 10~19 years	☐	④ over 20 years	☐

7. Please tick one box to show how long you have been worked in your company.

① less than five years	☐	② five~nine years	☐	③ 10~19 years	☐	④ over 20 years	☐

8. What is your company's name? (   )

9. If you would like to receive an executive summary of this study, please write down your email address here. (   )

End of questionnaire. Thank you for your help

Appendix 8 Final questionnaire

INTERNATIONAL SHIPPING AND LOGISTICS WITH PLYMOUTH UNIVERSITY

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Logistics and supply chain cooperative and collaborative spirit indices in South Korea

Dear

As an expert, please could you spare a few moments to answer the following questions. As a PhD researcher in Plymouth Graduate School of Management (www.plymouth.ac.uk/schools/plymouth-business-school), my research aims to develop a cooperative and collaborative spirit index between shipping companies and shippers within South Korea as a case study of collaboration in supply chains. I am researching the extent to which shippers have cooperative and collaborative attitudes towards shipping companies in logistics chains from the stance of shipping companies.

Since the turnover of shipping companies depends on business transactions with shippers, a cooperative and collaborative relationship between shipping companies and shippers in supply chains is essential. Therefore, a cooperative and collaborative spirit between shipping companies and shippers underpins stable and sustainable growth of shipping companies within supply chains.

The shipping industry of South Korea has had a difficult time with excess supply of shipping space caused by the emergence of larger ships and reduction of demand led by slow recovery of the world economy since the 2008 financial crisis. The cordial exertion of a cooperative and collaborative spirit of a shipper towards a shipping company, as a confident partner, may be conducive to overcoming difficulties which the shipping industry faces.

On page 3 is a questionnaire based on the opinions of public officials, staff members of associations and survey institutes, professors and industrial experts engaged in supply chains in South Korea. Based on this survey, cooperative and collaborative indices of ocean-going shipping and coastal shipping as well as container and bulk sectors will be computed to identify how the relationship between shipping companies and shippers can be improved.

Any information you offer will be used only for academic purposes and all information about shipping companies will be treated in the strictest confidence.

It may take about 15 minutes to complete this questionnaire. If you have any questions about this survey, please contact me. If you would like to receive an executive summary of my findings, please enter your email address in ninth question in section D. Thank you for your help.

Chang Soo Kim

SECTION A	Instructions

1. The questionnaire is comprised of three sections.
   - Section B provides six constructs which were identified to describe a cooperative and collaborative spirit between shipping companies and shippers.
   - Section C suggests 28 statements to measure the six constructs. Four or eight statements per construct are offered and you are asked for your opinion of each statement on a seven-point rating scale comprising 'Strongly disagree', 'Disagree', 'Slightly disagree', 'Neutral', 'Slightly agree', 'Agree', 'Strongly agree'.
   - Section D consists of questions related to your profile such as where a shipping company is registered, whether it is engaged in ocean-going shipping or coastal shipping, and shipping space which a shipping company is holding.
2. If your shipping company has no business transaction with shippers in South Korea, please do not respond.
3. If your shipping company is registered to manage both ocean-going shipping and coastal shipping in South Korea, please fill in two separate questionnaires: one in the positon of a shipping company registered in ocean-going shipping and the other in the position of the company registered in costal shipping.
4. This questionnaire classifies vessels into the following eight types based on the types of vessels registered in South Korea:
   - Container ship,
   - Bulk carrier (including grain, ore, coal, cement, timber, steel product, car)
   - Crude oil tanker
   - LPG/LNG tanker
   - Product /chemical carrier,
   - General cargo vessel
   - Tug and barge
   - Others (such as a refrigerated vessel)

   If your shipping company is registering several types of vessels in South Korea, please fill in the same number of copies of questionnaires as the number of the types. This is because different shippers may exist according to different types of vessels.

   ※ *For example, if your shipping company has four types of vessels such as bulk carrier, crude oil tanker, LPG tanker, and chemical carrier, please fill in separately a copy of questionnaire for each type of vessel (the same four copies of questionnaires as four types of the registered vessels).*

SECTION B	The explanation of the constructs

◈ This research identified six constructs (including a construct having a negative meaning) which are shown below. These represent the cooperative and collaborative spirit of shippers as previously described in the academic literature. The table below also includes broad definitions about the six constructs. After reading the broad definitions, please answer the statements on the next pages.

Construct	Broad Definition
1. Transparency	The extent to which shippers have an open and transparent relationship with shipping companies such as smooth communication, information sharing, and clear setting-up of the relationship through prior agreement
2. Fairness	The extent to which shippers treat shipping companies fairly and justly such as no discrimination between shipping companies, observation of related regulations and laws, and guarantee of reasonable and just profits for shipping companies
3. Mutuality	The extent to which shippers are willing to support shipping companies such as understanding their shipping service and offering material or financial assistance and treat shipping companies as an equal business partner such as joint settling of business plans or objectives, joint endeavours to improve the business and joint performance review
4. Trust	The extent to which shippers can be trusted such as good faith, fulfilment of contractual obligations, and providing benefits
5. Sustainability	The extent to which shippers sustain and strengthen continuously their relationship with shipping companies such as joint development of new business plans and joint expansion to new markets
6. Power	The extent to which shippers exert their superior power towards shipping companies

SECTION C	Text of the questionnaire

※ After reading the following statements, please insert "X" in the column under the number that you think match your view most closely.

※ 1=Strongly disagree, 2=Disagree, 3=Slightly disagree, 4=Neutral, 5=Slightly agree, 6=Agree, 7=Strongly agree

C-1	**Transparency**: This section measures the extent to which shippers have an open and transparent relationship with shipping companies	← Disagree				Agree →		
		1	2	3	4	5	6	7
1	Shippers exchange relevant and timely information with our firm							
2	Shippers and our firm communicate smoothly with each other through various channels such as regular or casual meeting between executives or between staffs							
3	Shippers make communication with our firm open and two-way							
4	The cooperative and collaborative relationship between shippers and our firm is understood clearly and transparently through prior agreements							

C-2	**Fairness**: This section measures the extent to which shippers treat shipping companies fairly and justly	← Disagree				Agree →		
		1	2	3	4	5	6	7
5	Shippers do not discriminate our firm against other shipping companies							
6	Shippers try to comply with the regulations related to business transactions such as standard form of contract and the laws related to fair trade such as 'Monopoly regulation and fair trade act' and 'Fair transactions in subcontracting act'							
7	Shippers make an effort to guarantee reasonable and just profits for our firm							
8	Shippers make an effort to bear reasonably and justly any additional risks, burden, and costs related to delivery with our firm							

※ 1=Strongly disagree, 2=Disagree, 3=Slightly disagree, 4=Neutral, 5=Slightly agree, 6=Agree, 7=Strongly agree

C-3	**Mutuality**: This section measures the extent to which shippers are willing to support shipping companies and treat shipping companies as an equal business partner	← Disagree				Agree →		
		1	2	3	4	5	6	7
9	Overall, shippers understand our firm's services well and are willing to provide any necessary assistance							
10	Shippers are willing to provide their facilities and equipment such as their dock, cranes, delivery vehicles with our firm (if shippers have such facilities and equipment)							
11	Shippers are willing to provide financial support such as guarantee of a bank loan required for procurement of vessels for our firm (if shippers have such financial capabilities)							
12	Shippers are willing to assist our firm in overcoming the difficulties when our firm is faced with any difficulties							
13	Shippers and our firm, as equal business partners, settle together common cooperative and collaborative implementation plans or objectives							
14	Shippers and our firm, as equal business partners, decide together the availability level of our facilities and equipment							
15	Shippers and our firm, as equal business partners, identify together customer needs related to delivery and try to improve the delivery quality jointly							
16	Shippers and our firm, as equal business partners, review together the performance of our firm							

※ 1=Strongly disagree, 2=Disagree, 3=Slightly disagree, 4=Neutral, 5=Slightly agree, 6=Agree, 7=Strongly agree

C-4	**Trust**: This section measures the extent to which shippers can be trusted	← Disagree				Agree →		
		1	2	3	4	5	6	7
17	Overall, shippers are trustworthy							
18	We believe the good faith of shippers when it comes to the relationship between shippers and our firm							
19	We believe that shippers fulfil their contractual obligations							
20	We believe that shippers benefit our firm							

C-5	**Sustainability**: This section measures the extent to which shippers sustain and strengthen continuously their relationship with shipping companies	← Disagree				Agree →		
		1	2	3	4	5	6	7
21	The relationship between shippers and our firm is stable							
22	The relationship between shippers and our firm will last and strengthen over time							
23	Shippers try to maintain their relationship with our firm such as developing together new business plans or ideas							
24	Shippers try to enhance continuously their relationship with our firm such as expanding jointly new markets (including foreign markets)							

C-6	**Power**: This section measures the extent to which shippers exert their superior power towards shipping companies	← Disagree				Agree →		
		1	2	3	4	5	6	7
25	Our contracts with shippers have many unfavourable clauses							
26	Shippers tend to request unreasonable delivery price deduction (including failure and delay of contract payment) or additional service demand							
27	We have suffered defamation of character or illegal and unreasonable requests such as bribery, lavish entertainment and preferential treatment							
28	We have experienced retaliation caused by refusal of illegal or unreasonable requests from shippers							

SECTION D	The respondent profile

※ Please answer the questions shown.

1. Please tick one box to show which type of shipping your company is registered for.

①☐ Coastal shipping
→ move to question 2

② ☐ Ocean-going shipping
→ move to question 2

③☐ Both coastal and ocean-going shipping
→ After completing question 1-1, move to question 2

1-1. Your company is registered for both coastal and ocean-going shipping. Which type of shipping did you mainly consider when you were filling in the Section C of this questionnaire?

※ Please, select only one answer here

①☐ Coastal shipping

② ☐ Ocean-going shipping

2. Please tick boxes to select all types of vessels which your company operates.

※ Several answers can be selected at the same time here

①☐ Container ship

②☐ Bulk carrier (including grain, ore, coal, cement, timber*, steel product*, car*)

③☐ Crude oil tanker

④☐ LPG/LNG tanker

⑤☐ Product/ chemical carrier

⑥☐ General cargo vessel

⑦☐ Tug and barge

⑧☐ Others** please specify (   )

* Can be included in neo bulk
** Such as a refrigerated vessel

If you selected several types of vessels simultaneously here, please move to <3> A shipping company operating several types of vessels (page 8) and if you selected single type of vessel, please move to <4> A shipping company operating single type of vessel (page 11)

<3> A shipping company operating several types of vessels

3-1. How many of the several types of vessels which you selected in question 2 does your company operate? (   ) And what is the total sum of gross registered tonnage of the vessels? (   )

※ Please fill in total number of vessels and gross registered tonnage including chartered vessels

3-2. Please tick one box to show how many permanent employees (including seafarers) your company employs in total.

①☐ Fewer than 10	②☐ 10~49	③☐ 50~99	④☐ 100~149
⑤☐ 150~199	⑥☐ 200~249	⑦☐ 250~299	⑧☐ More than 300

3-3. Please tick one box to show approximately how long the average period of contracts with shippers of the several types of vessels is.

①☐ Less than one year	②☐ One year~two years	③☐ Three~four years
④☐ Five~nine years	⑤☐ Over ten years	

3-4. Which one type of vessel did you mainly consider among the several types of vessels when you were completing Section C of this questionnaire?

※ Please, select only one answer here

①☐ Container ship	②☐ Bulk carrier (including grain, ore, coal, cement, timber*, steel product*, car*)	③☐ Crude oil tanker	④☐ LPG/LNG tanker
⑤☐ Product/ chemical carrier	⑥☐ General cargo vessel	⑦☐ Tug and barge	⑧☐ Others** please specify ( )

* Can be included in neo bulk
** Such as a refrigerated vessel

If you chose ②Bulk carrier, please answer questions 3-5 and 3-6 first and then move to question 3-9 (page 10) and if you selected ⑥General cargo vessel, please answer questions 3-7 and 3-8 first and then move to question 3-9 (page 10). [If you chose other types of vessels, please move directly to question 3-9 (page 10)]

<Bulk carrier>

3-5. You selected ②bulk carrier in question 3-4. Please tick boxes to show all types of cargoes of the carrier. *※ Several answers can be selected at the same time here*

①□ Grain	②□ Ore	③□ Coal	④□ Cement
⑤□ Timber	⑥□ Car	⑦□ Steel product	⑧□ Others please specify (　　)

→ *<u>If you select several answers, please move to next question 3-6 and if you choose single answer, please move to question 3-9 (next page)</u>*

3-6. Which one type of cargo did you mainly consider among the several types of cargoes which you chose in the above question 3-5 when you were completing Section C of this questionnaire? *※ Please, select only one answer here*

①□ Grain	②□ Ore	③□ Coal	④□ Cement
⑤□ Timber	⑥□ Car	⑦□ Steel product	⑧□ Others please specify (　　)

→ *<u>Please, move to question 3-9 (next page)</u>*

<General cargo>

3-7. You selected ⑥General cargo vessel in question 3-4. Please tick boxes to show all types of cargoes of the general cargo vessel. *※ Several answers can be selected at the same time here*

①□ Grain	②□ Ore	③□ Coal	④□ Cement
⑤□ Timber	⑥□ Car	⑦□ Steel product	⑧□ Others please specify (　　)

→ *<u>If you select several answers, please move to next question 3-8 and if you choose single answer, please move to question 3-9 (next page)</u>*

3-8. Which one type of cargo did you mainly consider among the several types of cargoes which you chose in the above question 3-7 when you were completing Section C of this questionnaire? *※ Please, select only one answer here*

①□ Grain	②□ Ore	③□ Coal	④□ Cement
⑤□ Timber	⑥□ Car	⑦□ Steel product	⑧□ Others please specify (　　)

→ *<u>Please, move to question 3-9 (next page)</u>*

3-9. How many of the single type of vessels which you selected in question 3-4 does your company operate? (   ) And what is the total sum of gross registered tonnage of the vessels? (   )

※ Please fill in total number of vessels and gross registered tonnage including chartered vessels

3-10. Please tick one box to show how many permanent employees in your company are engaged in the single type of vessel which you selected in question 3-4. (Please include seafarers and staff working in departments such as general affairs, planning and finance)

①□ Fewer than 10 ②□ 10~49 ③□ 50~99 ④□ 100~149
⑤□ 150~199 ⑥□ 200~249 ⑦□ 250~299 ⑧□ More than 300

3-11. Considering only the single type of vessel selected in question 3-4, please tick one box to show how long the average period of contracts with shippers related to the single type of vessel is.

①□ Less than 1 year ②□ 1 year~2 years ③□ 3~4 years
④□ 5~9 years ⑤□ More than 10 years

→ *Please, move to next question 5 (page 13)*

<4> A shipping company operating single type of vessel

If you chose ②Bulk carrier in question 2, please answer questions 4-1 and 4-2 first and then move to question 4-5 (page 12) and if you selected ⑥General cargo vessel in question 2, please answer questions 4-3 and 4-4 first and then move to question 4-5. [If you chose other types of vessels, please move directly to question 4-5 (page 12)]

<Bulk carrier>

4-1. You selected ②bulk carrier in question 2. Please tick boxes to show all types of cargoes of the carrier. *※ Several answers can be selected at the same time here*

①☐	Grain	②☐	Ore	③☐	Coal	④☐	Cement
⑤☐	Timber	⑥☐	Car	⑦☐	Steel product	⑧☐	Others please specify ( )

→ *If you select several answers, please move to next question 4-2 and if you choose single answer, please move to question 4-5 (next page)*

4-2. Which one type of cargo did you mainly consider among the several types of cargoes which you chose in the above question 4-1 when you were filling in Section C of this questionnaire? *※ Please, select only one answer here*

①☐	Grain	②☐	Ore	③☐	Coal	④☐	Cement
⑤☐	Timber	⑥☐	Car	⑦☐	Steel product	⑧☐	Others please specify ( )

→ *Please, move to question 4-5 (next page)*

<General cargo vessel>

4-3. You selected ⑥General cargo vessel in question 2. Please tick boxes to show all types of cargoes of the vessel. *※ Several answers can be selected at the same time here*

①☐	Grain	②☐	Ore	③☐	Coal	④☐	Cement
⑤☐	Timber	⑥☐	Car	⑦☐	Steel product	⑧☐	Others please specify ( )

→ *If you select several answers, please move to next question 4-4 and if you choose single answer, please move to question 4-5 (next page)*

4-4. Which one type of cargo did you mainly consider among the several types of cargoes which you chose in the above question 4-3 when you were filling in Section C of this questionnaire? *※ Please, select only one answer here*

①☐ Grain	②☐ Ore	③☐ Coal	④☐ Cement
⑤☐ Timber	⑥☐ Car	⑦☐ Steel product	⑧☐ Others please specify ( )

→ *Please, move to question 4-5 (next page)*

4-5. How many of the single type of vessels which you selected in question 2 does your company operate? ( ) And what is the total sum of gross registered tonnage of the vessels? ( )

※ Please fill in total number of vessels and gross registered tonnage including chartered vessels

4-6. Please tick one box to show how many permanent employees (including seafarers) your company employs in total.

①☐ Fewer than 10	②☐ 10~49	③☐ 50~99	④☐ 100~149
⑤☐ 150~199	⑥☐ 200~249	⑦☐ 250~299	⑧☐ More than 300

4-7. Please tick one box to show approximately how long the average period of contracts with shippers is.

①☐ Less than 1 year	②☐ 1 year~ 2 years	③☐ 3~4 years
④☐ 5~9 years	⑤☐ More than 10 years	

→ *Please, move to next question 5 (next page)*

5. Please tick one box to show what your current positon is in your company.

①□ Staff	②□ Assistant Manager	③□ Manager	④□ Deputy Department Manager
⑤□ Department Manager	⑥□ Director/Senior Director	⑦□ CEO	

6. Please tick one box to show how long you have been engaged in the shipping industry.

①□ Less than five years	②□ Five~nine years	③□ 10~19 years	④□ Over 20 years

7. Please tick one box to show how long you have been worked in your company.

①□ Less than five years	②□ Five~nine years	③□ 10~19 years	④□ Over 20 years

8. What is your company's name? (   )

9. If you would like to receive an executive summary of this study, please write down your email address here. (   )

End of questionnaire. Thank you for your help

Appendix 9 Mahalanobis d-squared of each observation

Case number	Mahalanobis d-squared	p1	p2	Case number	Mahalanobis d-squared	p1	p2
107	83.009	0.000	0.000	125	27.048	0.302	0.494
31	80.773	0.000	0.000	88	26.375	0.334	0.761
74	64.23	0.000	0.000	15	26.015	0.352	0.848
14	62.894	0.000	0.000	132	25.59	0.374	0.926
101	62.856	0.000	0.000	131	25.39	0.385	0.941
116	58.356	0.000	0.000	117	25.294	0.390	0.938
154	54.883	0.000	0.000	60	25.271	0.391	0.920
106	54.038	0.000	0.000	30	25.122	0.399	0.927
143	52.807	0.001	0.000	36	25.122	0.399	0.902
65	51.633	0.001	0.000	37	25.122	0.399	0.871
59	50.89	0.001	0.000	11	24.906	0.411	0.900
90	50.19	0.001	0.000	66	24.815	0.416	0.895
115	49.617	0.002	0.000	148	23.933	0.465	0.991
41	49.395	0.002	0.000	68	23.826	0.472	0.991
40	45.555	0.005	0.000	98	23.548	0.488	0.996
138	44.237	0.007	0.000	96	23.473	0.492	0.995
109	43.793	0.008	0.000	67	23.459	0.493	0.993
32	42.506	0.011	0.000	95	23.035	0.518	0.998
160	41.829	0.013	0.000	151	22.917	0.525	0.998
137	40.985	0.017	0.000	163	22.729	0.536	0.999
4	40.609	0.018	0.000	97	22.723	0.536	0.998
161	40.546	0.019	0.000	111	22.644	0.541	0.998
159	40.494	0.019	0.000	142	22.189	0.568	1.000
33	39.96	0.022	0.000	58	22.005	0.579	1.000
119	39.215	0.026	0.000	141	21.978	0.581	1.000
3	36.424	0.050	0.000	34	21.974	0.581	1.000
39	35.932	0.056	0.000	144	21.908	0.585	1.000
158	35.368	0.063	0.000	93	21.8	0.591	1.000
136	34.493	0.076	0.000	80	21.768	0.593	0.999
35	34.074	0.083	0.000	140	21.397	0.615	1.000
127	33.773	0.089	0.000	61	21.302	0.621	1.000
87	33.633	0.091	0.000	81	21.075	0.634	1.000
16	33.152	0.101	0.000	122	20.888	0.645	1.000
57	32.827	0.108	0.000	123	20.888	0.645	1.000
54	32.482	0.115	0.000	82	20.798	0.651	1.000
108	32.208	0.122	0.000	13	20.513	0.667	1.000
29	31.885	0.130	0.001	25	20.369	0.676	1.000
149	31.05	0.152	0.007	133	20.36	0.676	1.000

Case number	Mahalanobis d-squared	p1	p2	Case number	Mahalanobis d-squared	p1	p2
162	30.954	0.155	0.005	85	20.323	0.678	1.000
157	30.856	0.158	0.004	52	19.673	0.715	1.000
89	30.78	0.160	0.003	99	19.628	0.718	1.000
113	30.554	0.167	0.004	92	19.264	0.738	1.000
78	30.067	0.183	0.010	104	19.042	0.750	1.000
75	29.637	0.197	0.022	167	18.847	0.760	1.000
129	29.101	0.216	0.061	10	18.84	0.760	1.000
94	29.074	0.217	0.045	5	18.767	0.764	1.000
145	28.142	0.254	0.233	9	18.481	0.779	1.000
146	28.142	0.254	0.183	155	18.232	0.792	1.000
27	27.83	0.267	0.247	26	18.166	0.795	1.000
56	27.466	0.283	0.349	18	18.087	0.799	1.000

Appendix 10 Normality test by SPSS

	Skewness	Std. error of skewness	z-value	Kurtosis	Std. error of kurtosis	z-value
TRA1	-0.219	0.188	-1.168	-0.822	0.374	-2.200
TRA2	-0.203	0.188	-1.082	-0.717	0.374	-1.919
TRA3	-0.090	0.188	-0.477	-0.867	0.374	-2.322
TRA4	-0.163	0.188	-0.867	-0.786	0.374	-2.103
FAI1	-0.284	0.188	-1.512	-0.559	0.374	-1.496
FAI2	-0.513	0.188	-2.731	-0.383	0.374	-1.025
FAI3	-0.007	0.188	-0.038	-0.805	0.374	-2.156
FAI4	0.166	0.188	0.885	-0.705	0.374	-1.887
MUT1	0.037	0.188	0.197	-0.671	0.374	-1.795
MUT2	-0.326	0.188	-1.733	-0.775	0.374	-2.073
MUT3	0.500	0.188	2.663	-0.725	0.374	-1.941
MUT4	0.375	0.188	1.998	-0.612	0.374	-1.638
MUT5	0.114	0.188	0.606	-0.757	0.374	-2.025
MUT6	0.147	0.188	0.780	-0.840	0.374	-2.249
MUT7	0.057	0.188	0.302	-0.800	0.374	-2.142
MUT8	0.328	0.188	1.748	-0.633	0.374	-1.693
TRU1	-0.334	0.188	-1.779	-0.163	0.374	-0.436
TRU2	-0.231	0.188	-1.230	-0.190	0.374	-0.508
TRU3	-0.583	0.188	-3.105	0.074	0.374	0.197
TRU4	-0.397	0.188	-2.113	-0.265	0.374	-0.710
SUS1	-0.354	0.188	-1.886	-0.054	0.374	-0.145
SUS2	-0.289	0.188	-1.539	-0.309	0.374	-0.828
SUS3	0.098	0.188	0.519	-0.661	0.374	-1.769
SUS4	0.099	0.188	0.528	-0.689	0.374	-1.843

Appendix 11 Assessment of normality by AMOS

Variable	Skew	Critical ratio	kurtosis	Critical ratio
SUS4	0.098	0.519	-0.704	-1.857
SUS3	0.097	0.51	-0.677	-1.786
SUS2	-0.286	-1.511	-0.336	-0.886
SUS1	-0.351	-1.853	-0.088	-0.233
TRU4	-0.393	-2.076	-0.293	-0.773
TRU3	-0.578	-3.05	0.036	0.094
TRU2	-0.229	-1.209	-0.22	-0.58
TRU1	-0.331	-1.747	-0.194	-0.511
FAI1	-0.282	-1.485	-0.578	-1.525
FAI2	-0.509	-2.683	-0.407	-1.074
FAI3	-0.007	-0.037	-0.817	-2.156
FAI4	0.165	0.869	-0.72	-1.898
MUT1	0.037	0.193	-0.686	-1.81
MUT2	-0.323	-1.703	-0.787	-2.077
MUT3	0.496	2.615	-0.739	-1.95
MUT4	0.372	1.963	-0.629	-1.66
MUT5	0.113	0.595	-0.77	-2.031
MUT6	0.145	0.767	-0.851	-2.245
MUT7	0.056	0.297	-0.812	-2.143
MUT8	0.326	1.717	-0.649	-1.713
TRA1	-0.217	-1.147	-0.833	-2.198
TRA2	-0.201	-1.063	-0.731	-1.929
TRA3	-0.089	-0.468	-0.877	-2.314
TRA4	-0.161	-0.852	-0.798	-2.105
Multivariate			164.672	30.119

Appendix 12 Test of homoscedasticity by SPSS

	Coastal and ocean-going				Vessel type			
	Levene statistic*	df1	df2	Sig.	Levene statistic	df1	df2	Sig.
TRA1	0.037	1	165	0.848	1.166	3	163	0.324
TRA2	0.001	1	165	0.981	0.892	3	163	0.447
TRA3	0.000	1	165	0.984	1.001	3	163	0.394
TRA4	0.753	1	165	0.387	1.244	3	163	0.295
FAI1	0.007	1	165	0.935	1.116	3	163	0.344
FAI2	0.188	1	165	0.665	1.921	3	163	0.128
FAI3	0.000	1	165	0.983	0.746	3	163	0.526
FAI4	1.122	1	165	0.291	2.204	3	163	0.090
MUT1	0.172	1	165	0.679	0.671	3	163	0.571
MUT2	0.000	1	165	0.985	0.876	3	163	0.455
MUT3	1.529	1	165	0.218	2.562	3	163	0.057
MUT4	3.020	1	165	0.084	1.127	3	163	0.340
MUT5	0.300	1	165	0.585	1.359	3	163	0.257
MUT6	1.895	1	165	0.170	1.688	3	163	0.172
MUT7	0.138	1	165	0.710	1.791	3	163	0.151
MUT8	0.065	1	165	0.799	1.988	3	163	0.118
TRU1	1.601	1	165	0.208	1.194	3	163	0.314
TRU2	1.815	1	165	0.180	0.402	3	163	0.752
TRU3	3.162	1	165	0.077	0.667	3	163	0.574
TRU4	0.383	1	165	0.537	0.835	3	163	0.476
SUS1	0.045	1	165	0.832	1.400	3	163	0.245
SUS2	1.811	1	165	0.180	1.075	3	163	0.361
SUS3	0.801	1	165	0.372	0.374	3	163	0.772
SUS4	4.292	1	165	0.040	0.292	3	163	0.831
POW1	0.106	1	165	0.745	1.133	3	163	0.337
POW2	2.219	1	165	0.138	0.305	3	163	0.822
POW3	0.530	1	165	0.468	0.145	3	163	0.933
POW4	0.062	1	165	0.804	0.203	3	163	0.894

* The values in each shell is the values based on mean among four values (based on mean, median, median with adjusted df, and trimmed mean which SPSS provides

Appendix 13 Exploratory factor analysis

1. Measures of factor analysis appropriateness

The adequacy of application of FA can be examined by the following three methods such as a partial correlation, the Bartlett test of sphericity, and the measure of sampling adequacy (MSA). A partial correlation (shown as the anti-image correlation matrix in SPSS) implies unexplained correlation when considering the effects of other variables. The higher partial correlations (above 0.7) indicate that underlying factors do not exist and that the FA is not adequate (Hair *et al.*, 2014).

The appropriateness of FA can also be identified by the Bartlett test of sphericity which tests for the presence of statistically significant correlations among the variables (Hair *et al.*, 2014). The null hypothesis of the Bartlett test is that the original correlation matrix is an identity matrix which means that all correlation coefficients among variables would be zero. Therefore, if the result of the test is significant then all correlation coefficients among variables are not zero, which signifies that FA is appropriate (Field, 2009).

The third method to judge the adequacy of FA is the MSA which is shown as Kaiser Meyer Olkin (KMO) MSA in SPSS (Hair *et al.*, 2014). The KMO statistic indicates whether the sample size is adequate for FA. The KMO statistic ranges from 0 to 1 and a value of 1 implies that reliable factors can be produced through FA because the patterns of correlations between variables is compact (Field, 2009). The score greater than 0.9 indicates appropriateness of FA whereas the score below 0.5 implies FA is barely acceptable (Hutcheson and Sofroniou, 1999; Hair *et al.*, 2014).

2. Factor extraction methods

How much variance a variable shares with other variables is important in FA given that FA groups variables having high correlation with each other and the square of correlation between two variables means shared variance of a variable with the other variable. The total variance of a variable consists of the following components (Hair *et al.*, 2014):

- Common variance: the variance the correlation of a variable with all other variables explains and increases as the correlation grows.
- Specific (unique) variance: the variance related to only a specific variable.
- Error variance: the variance cannot be accounted for by the correlation between a variable and other variables.

In this context, the portion of common variance in a variable which factors explain is defined as communality and the communalities have a very positive relationship with the number of factors retained (Field, 2009).

The methods for defining the factors can be divided into CFA2 and PCA by what types of variance are used (Hair *et al.*, 2014). PCA which is a default method in many statistical software packages including SPSS takes into account the total variance whereas in CFA2, only the shared (common) variance is considered (Ford *et al.*, 1986; Osborne and Costello, 2009; Hair *et al.*, 2014). PCA does not distinguish between shared variance and unique variance whereas CFA2 partitions the shared variance of a variable from its unique and error variance (Osborne and Costello, 2009). PCA and CFA2 can also be differentiated from their major objectives: data reduction (PCA) and identification of latent constructs (CFA2) (Osborne and Costello, 2009; Hair *et al.*, 2014). The conclusions of PCA are limited to the sample and cannot be extended to generalisation whereas those of CFA2 such as Maximum Likelihood (ML) can be extended to generalisation (Field, 2009). Although CFA2 is regarded as having more theoretical foundation, PCA is more widely used owing to a more complicated property of CFA2. Generally, the CFA2 has lower loadings compared to PCA because of the lower communalities of the variable (Hair *et al.*, 2014). However, the basic interpretations about factors do not differ between the two methods if the number of variables exceeds 30 (Stevens, 2009; Hair *et al.*, 2014) and the communalities exceed 0.6 (Hair *et al.*, 2014) or 0.7 (Stevens, 2009) for most variables.

With regard to the types of the factor extraction of CFA2, SPSS provides six methods: unweighted least squares, Generalised Least Squares (GLS), ML, principal axis factoring (PAF), alpha factoring, and image factoring (Osborne and Costello, 2009). The complication and difficulty about which extraction method among the above six should be chosen is another reason for the popularity of the PCA (Osborne and Costello, 2009). The ML has been most widely utilised among the six methods (Fabrigar *et al.*, 1999; Hair *et al.*, 2014). ML is more efficient and unbiased on the assumption that multivariate normality is met. The potential sensitivity of ML to non-normality led to the development of alternative methods such as weighted least squares (WLS) and GLS (Hair *et al.*, 2014). ML has major advantage such as the provision of the Goodness-Of-Fit

(GOF) of the model, testing of significance of factor loadings and correlations among factor loadings, and the suggestion of confidence intervals (Cudeck and O'Dell, 1994; Fabrigar *et al.*, 1999). When the assumption of normal distribution is not observed, PAF can be an alternative to ML (Fabrigar *et al.*, 1999). The comparison between the least squares and ML indicates that ML seems to be distinctly preferable in terms of more satisfactory solutions with some additional information (Goldfeld, 1971). Among the extraction methods of CFA2, ML or PAF would be the best choice (Osborne and Costello, 2009).

3. Criteria for the extraction of factors

The following guidelines for the selection of factors are currently used (Hair *et al.*, 2014, pp.107-108).

- Latent roots (eigenvalues): the factors with eigenvalues over 1 are regarded as significant and should be chosen in that the variance of at least one variable should be explained by any one factor.
- *A priori* criterion: when the researcher knows the number of factors to be extracted, this criterion is reasonable.
- Percentage of variance: successive factors should explain a specified cumulative percentage of total variance. In social science, at least 60 percent of the total variance is considered satisfactory.
- Scree test: factors (points) before the inflection point in a scree plot are considered to explain a substantial portion of the common variance and are chosen.

The combination of the above criteria should be employed when it comes to determining how many factors should be retained.

4. Factor rotation methods

Rotation makes the loadings of variables on one factor maximised while the loadings on all other factors are being minimised (Field, 2009). The interpretation improvement of initial unrotated factor matrix can be achieved by rotation. In other words, a simpler and theoretically more meaningful factor pattern can be achieved by rotation of the initial factor matrix (Hair *et al.*, 2014).

Factor rotation can be partitioned into orthogonal and oblique methods according to how the reference axes of the factors are turned about the origin (Hair *et al.*, 2014). The orthogonal rotation maintains the factor axes at 90 degrees which means the independence between the factors (Field, 2009; Hair *et al.*, 2014). In contrast, the oblique rotation is more flexible and realistic in that the method does not require the axes to be maintained at 90 degrees which assumes that the theoretically underlying dimensions are correlated (Field, 2009; Hair *et al.*, 2014). To put it another way, orthogonal rotations cause uncorrelated factors whereas oblique methods permit the factors to be correlated with each other (Osborne and Costello, 2009). The factor loadings derived by orthogonal rotation signify both the correlation coefficients and the regression coefficient whereas those by oblique rotation are differentiated, i.e. factor loadings in the factor structure matrix are the correlation coefficients and factor loadings in the factor pattern matrix are the regression coefficients (Graham *et al.*, 2003; Field, 2009).

There are three major orthogonal approaches: varimax, quartimax and equamax. The varimax approach has been widely used as an analytic method of orthogonal factor rotation because quartimax and equimax have not been successfully proved (Field, 2009; Osborne and Costello, 2009; Hair *et al.*, 2014). Unlike the orthogonal method, only limited approaches for oblique rotations such as oblimin and promax in SPSS exist (Field, 2009). This is why the orthogonal rotation approaches are more widely utilised (Hair *et al.*, 2014). Among oblique rotated methods, oblimin is recommended in that promax is suitable for very large data sets (Field, 2009).

Although general guidelines or analytical reasons regarding which rotation method should be chosen do not exist (Hair *et al.*, 2014), the choice of rotation is affected by a theoretical background which tends to support that the factors are correlated or independent (Field, 2009). If a correlated factor structure is revealed through oblique rotation, then the orthogonal rotated solution might not be acceptable (Pedhazur and Schmelkin, 2013).

5. Guidelines for the selection of factor loadings

The importance of a factor loading is as follows: "because a factor loading is the correlation of the variable and the factor, the squared loading is the amount of the variable's total variance accounted for by the factor" (Hair *et al.*, 2014, p.114). There is an argument that if four or more loadings over 0.6 are found in a factor, then the result is reliable irrespective of sample size (Guadagnoli and Velicer, 1988). However, sample size generally affects the significance of a factor loading (Field, 2009) and the factor loading of an item functions as one criterion in deciding whether the item should be retained or discarded (Hair *et al.*, 2014). Guidelines for the practical and statistical significance of factor loadings connected with sample size can be suggested as follows (Hair *et al.,* 2014):

Table A13-1 Practical significance of factor loadings (100 or larger sample size)

Factor loading	Practical significance
±.30 to ±.40	the minimal level
±.50 or greater	practically significant
over ±.70	well-defined structure

Source: Adopted from Hair *et al.* (2014)

Table A13-2 Guidelines for identifying significant factor loading with sample size

Factor loading	Sample size needed for significance*
.30	350
.35	250
.40	200
.45	150
.50	120
.55	100
.60	85
.65	70
.70	60
.75	50

Source: Hair *et al.* (2014, p.115), * 0.05 significant level

Generally, variables having a cross loading, having more than one significant loading on factors should be deleted if there are not any theoretical justifications. In addition, variables with communalities over 0.5 should be retained (Hair *et al.*, 2014).

Appendix 14 Structural equation modelling

1. General description of structural equation modelling

SEM is based on particularly FA and multiple regression analysis (hypotheses test) (Gefen *et al.*, 2000). SEM is regarded as a better way of empirically examining a theoretical model than multiple regression analysis. This is because SEM considers information about measurement in the test of the structural model whereas the multiple regression analysis does not consider any measurement properties in estimating the relationships among constructs (Hair *et al.*, 2014).

SEM incorporates latent variables and measurement errors in the analysis (Byrne, 2010; Hair *et al.*, 2014). In SEM, a measurement error is associated with an observed variable whereas a residual is an error related to latent variables. A residual is caused by the prediction of endogenous factors from exogenous factors (Byrne, 2010). A measurement error and a residual are usually termed as a measurement error. Latent variables represented by multiple measures can reduce their own measurement errors. The introduction of the measurement errors can improve the statistical estimation of the relationship between the latent variables (Hair *et al.*, 2014). In contrast, traditional multivariate methods assume that errors in the independent variables vanish and consider only observed measurements (Byrne, 2010). Explaining the measurement errors in the latent constructs, the structural model of SEM provides the estimations about the relationships among constructs when no measurement errors exist. This is why the SEM relationship coefficients tend to be larger than the similar type of coefficients that multiple regression provides (Hair *et al.*, 2014).

The entire set of relationships among latent constructs and between latent constructs and indicators can be explained in a single SEM model (Hair *et al.*, 2014). SEM models estimate simultaneously multiple and interrelated dependence relationships among independent and dependent variables whereas other multivariate techniques such as multiple regression analysis and MANOVA estimate only one layer of relationships between dependent and independent variables at a time (Gefen *et al.*, 2000; Hair *et al.*, 2014).

Unlike other multivariate techniques, SEM allows a construct which functions as an independent variable in a relationship to be a dependent variable in another relationship (Hair *et al.*, 2014). Another difference of SEM is that the focus of SEM is on a covariance structure analysis however other multivariate techniques focus on a variance analysis (Byrne, 2010; Hair *et al.*, 2014).

With regard to sample size, there are five considerations affecting sample size for SEM such as multivariate normality, estimation technique, model complexity, missing data and model characteristics. The following minimum sample size guidelines for SEM in line with model complexity and measurement model characteristics can be provided (Hair *et al.*, 2014):

Table A14-1 Minimum sample size guidelines for SEM

Minimum sample size	Constructs	Items	Communality
100	five or fewer	more than three per construct	0.6 or higher
150	seven or fewer	no under-identified construct*	0.5
300	seven or fewer	fewer than three under-identified constructs	below 0.45

Source: Adopted from Hair *et al.* (2014), * A construct associated with two or less items

In simple terms, as the number of constructs increases, a larger sample size and a reduced communality are required unless there are fewer items per construct. In addition, where data deviates from multivariate normality, where a sample-intensive estimation method such as asymptotically distribution free is selected, or where missing data exceeds 10 percent, a larger sample is required (Hair *et al.*, 2014). With respect to indicators per factor, if a model has three or more indicators per factor, then a sample size of 150 is usually sufficient (Anderson and Gerbing, 1984). As a rule of thumb, between 5 and 10 observations for each parameter estimate should be achieved (Medsker *et al.*, 1994; Baumgartner and Homburg, 1996)

SEM can be applied to the following three types of modelling techniques (scenarios) (Jöreskog and Bollen, 1993; Byrne, 2010; Hair *et al.*, 2014)

- Confirmatory modelling: SEM assesses a single model consisting of a set of relationships based on theory. SEM identifies how well the model suits the data. An acceptable model fit supports the model. Additional modifications to the model are not made.
- Competing or alternative modelling: An estimated model is compared with alternative models. Several alternative models based on their own theories are proposed. Equivalent models which have as good model fit as the proposed model can be revealed through the comparison. The comparison between a proposed model and a competing or alternative model can be performed by assessing differences between GOF indices for each model (Hair *et al.*, 2014). Competing models can also be

compared by a Chi square (χ^2) difference statistic ($\Delta\chi^2$) (Hair *et al.*, 2014). Chi-square (χ^2) difference statistic ($\Delta\chi^2$) itself follows Chi-square (χ^2) distribution (Bentler, 1980; Hair *et al.*, 2014). If a competing and a proposed models show one degree of freedom difference (Δdf= 1) and the Chi- square (χ^2) statistics of the two models is significantly different (i.e. $\Delta\chi^2$ is over 3.84 at the significance level of 0.05), it can be concluded that the competing or alternative model has a significantly better model fit than the proposed model (Hair *et al.*, 2014). Following the result of empirical analysis, one model which is considered to most appropriately represent the sample data can be chosen. The more complex model has the possibility to have more equivalent models.

- Model generation modelling: SEM provides not only the empirical test results of a proposed model but also insights into its re-specification. The modification and re-estimation of a model with poor fit or rejected hypotheses are conducted in an exploratory way rather than confirmatory. The source of misfit in a model is repeatedly examined and the model most representing the sample data is selected. This type of modelling is the most common. However, the model re-specification needs a theoretical support not just empirical justification.

Model misspecification can be detected by additional diagnostic information such as standardised residuals and Modification Indices (MIs) provided by CFA1 (Byrne, 2010; Hair *et al.*, 2014). In spite of such diagnostics, any changes of the proposed measurement model based only on empirical criteria provided by CFA1 should be avoided.

The residuals which are divided by the standard error of the residual are referred to as the standardised residuals (Hair *et al.*, 2014). The pattern of the residuals is one of the most useful ways for detecting the source of misspecification (Anderson and Gerbing, 1988). The existence of cross loadings of an item can produce large residuals between the item and different items from different factors (Steenkamp and Van Trijp, 1991). Standardised residuals over $\pm$2.58 are regarded as large (Jöreskog and Sörbom, 1993; Medsker *et al.*, 1994). Typically, standardised residuals over $|4.0|$ can cause a problem (Hair *et al.*, 2014).

A MI can be conceptualised as a χ^2 statistic with one degree of freedom (Jöreskog and Sörbom, 1993). The indices can be computed through the estimates of all possible relationships which are not estimated in a proposed model (Hair *et al.*, 2014). A MI shows the expected decrease in overall χ^2 value if each parameter were to be estimated (Byrne, 2010). Large MIs can indicate the presence of problematic items that could have cross loadings and error covariances if specified (Byrne, 2010; Hair *et al.*, 2014).

Measurement error covariances reflect systematic measurement error in the related items. Measurement error covariances can be caused by characteristics specific to associated items or to respondents and by a high degree of overlap in contents of the related items (Byrne, 2010). For improvement of model fit, estimation of correlated measurement errors are often utilised *post hoc* irrespective of the interpretative improvement of a model (Fornell, 1983; Gerbing and Anderson, 1984). Such estimation can lead to ambiguity in reliability estimates (Bollen, 1989). More than half of articles introduced correlated errors did not suggest any justification for the use of the correlated errors (Shah and Goldstein, 2006). Only when theoretical or methodological justification supports the introduction of the errors, should the correlated measurement errors be utilised (Fornell, 1983). MIs of about 4.0 or greater (Hair *et al.*, 2014) or over 7.88 (Jöreskog and Sörbom, 1993) are considered large.

Estimating corresponding paths according to large MIs could improve significantly the model fit (Bentler and Chou, 1987; Garver and Mentzer, 1999; Hair *et al.*, 2014). However, the re-specification of an originally hypothesised model based only on the indices should be avoided (Bentler and Chou, 1987; Garver and Mentzer, 1999; Hair *et al.*, 2014). Any changes of the initially proposed model should be conducted with other residual diagnostics and justification by theory (Bentler and Chou, 1987; Garver and Mentzer, 1999; Hair *et al.*, 2014). In other words, a strong substantive and empirical rationale has to support the model re-specification (Bollen and Long, 1993). Strictly speaking, establishing re-specification of the initially proposed model falls within the process of a *post hoc* analysis and has exploratory nature (Byrne, 2010). However, the comparison of the final re-specification model with the proposed model can be one way of establishing some validity to the re-specification (Bentler and Chou, 1987).

A specification search implies an empirical trial-and-error to identify new relationships that best improve the model fit. The search can be performed by estimating fixed paths with the largest MI (Hair *et al.*, 2014). However, specification research is not recommended in that CFA1 tests a proposed theory in a confirmatory approach, rather than an exploratory approach (Byrne, 2010). Furthermore, the mechanical specification search cannot be trustworthy in identifying a true model. Therefore, CFA1 specification searches should be restricted to identifying only a small number of major problems in the proposed model. Although a model re-specification is commonly performed, the re-specification such as items deletion should also be made only after careful considerations including identification requirements, the number of items per factor, construct validity and a proposed theory (Hair *et al.*, 2014).

In addition, considerations should be involved such as whether inclusion of additional parameters into the model is meaningful or not, whether the proposed model shows adequate fit or not, and whether expected parameter change is substantial or not (Byrne, 2010).

2. Goodness-of-fit of a measurement model

SEM determines whether the entire model should be accepted or rejected based on the extent of acceptance of overall model fit before any specific relationships are examined. A model fit implies how well a theory explains the reality. A model fit is produced on the basis of the correspondence between an observed covariance matrix coming from an input data and an estimated covariance matrix coming from a proposed model. If the two matrices match each other closely, the constructs are considered to be defined adequately by the measurement model. The differences between the observed and the estimated covariance matrices are defined as the residuals matrix. When the two matrices are sufficiently close to each other, that is, the matrix of residuals is small, then the model is supported (Hair *et al.*, 2014).

GOF measures are grouped into the following three categories: absolute, incremental, and parsimony fit measures (Hair *et al.*, 2014; Byrne, 2010).

Absolute fit indices measure directly how well observed data are reproduced by a specified model (Hair *et al.*, 2014). The indices do not compare a proposed model with any models (Byrne, 2010). Absolute fit indices include Chi-square (χ^2) statistic, Goodness-of-fit index (GFI), Root Mean Square Error of Approximation (RMSEA), Root Mean square Residual (RMR), Standardised Root Mean Residual (SRMR) and Normed Chi-square (χ^2) (Hair *et al.*, 2014).

Chi-square (χ^2) statistic is the most fundamental absolute fit index in measuring differences between the observed and estimated covariance matrices. Chi-square (χ^2) is mathematically defined as the following equation [Appendix 14.1] (Hair *et al.*, 2014):

$$\chi^2 = (N - 1)\ (S - \textstyle\sum_k) \qquad \text{[Appendix 14.1]}$$

In the equation, N denotes the overall sample size, S observed sample covariance and $\sum_k$ SEM estimated covariance matrix. Therefore, (S - $\sum_k$) implies the residual covariance matrix. Chi-square (χ^2) is dictated by the sample size and the number of specified or estimated (free) parameters (k). To put it another way, if the sample size increases, the value of Chi-square (χ^2) will grow. The greater residual matrix leads to the increment of Chi-square (χ^2) value. The number of specified or estimated parameters (k) also determines the degrees of freedom of a SEM model. The formula of the number of degrees of freedom (df) for a SEM is as follows (Hair *et al.*, 2014):

$$df = \frac{1}{2}[(p)(p+1)] - k \qquad \text{[Appendix 14.2]}$$

Where, p is the total number of observed variables and k is the number of estimated parameters. 1/2[(p)(p+1)] denotes the sum of the number of covariance terms and variance terms. Degrees of freedom of other multivariate techniques are derived from a sample size whereas those of SEM are from a size of the covariance (Hair *et al.*, 2014). To sum up, the greater number of observed variables and the smaller number of estimated parameters tend to increase degrees of freedom and Chi-square (χ^2) value (Marsh and Hocevar, 1985).

The implied null hypothesis of SEM is the equivalence between the observed and estimated covariance matrices (Hair *et al.*, 2014). With the χ^2 value, the statistical probability (traditional p-value) about the equivalence is tested (Hair *et al.*, 2014). If the χ^2 value is smaller and the probability related to the χ^2 becomes higher, the degree of the equivalence becomes closer (Byrne, 2010). A small and statistically significant p-value for the χ^2 test (a relatively large χ^2 value) indicates that the two matrices are statistically different and the GOF of the model can be problematic. A proposed theoretical model can be supported by a relatively small χ^2 value (large p-value) (Hair *et al.*, 2014). Unlike traditional significance testing, a nonsignificant Chi-square (χ^2) is preferred in GOF test (Marsh and Hocevar, 1985). A nonsignificant chi-square (χ^2) implies the observed covariance matrix is not considerably different from the estimated matrix (Garver and Mentzer, 1999). Therefore, a low chi-square value representing a good model fit is pursued (Marsh and Hocevar, 1985; Garver and Mentzer, 1999).

However, Chi-square (χ^2) GOF statistics have two biases in terms of sample size and increased model complexity. As seen in the above two equations [Appendix 14.1] and [Appendix 14.2], if the sample size (N) and the number of observed variables increases, the value of Chi-square (χ^2) statistic tends to be greater, which means model fit cannot be achieved in spite of academic recommendations such as large sample size and more constructs or indicators (Hair *et al.*, 2014). In addition, Chi-square (χ^2) is very sensitive to the deviation from multivariate normality (Marsh and Hocevar, 1985). For these reasons, in most SEM empirical research, it has been proved that findings of well-fitting hypothesised models are unrealistic and findings of relatively large χ^2 value are more common (Byrne, 2010).

Therefore, a number of alternative GOF measures have been developed because GOF of a model cannot fully be assessed with only a Chi-square (χ^2) value. The Chi-square (χ^2) GOF test should be complemented with other alternative measures of fit correcting for the problematic properties of the test (Hair *et al.*, 2014). However, given the importance of Chi-square (χ^2), the Chi-square (χ^2) value and degrees of freedom of a model should be reported (Hair *et al.*, 2014).

GFI measures the relative amount of variance and covariance in the observed covariance matrix (Byrne, 2010). GFI creates a fit statistic with less sensitivity to sample size. The higher values of GFI indicate better model fit and typically GFI values exceeding 0.90 are considered good (Hair *et al.*, 2014). However, it is better not to report GFI because of its poor performance (Hu and Bentler, 1999).

RMSEA attempts to fix the two biases of the Chi-square (χ^2) test statistic. The provision of a confidence interval is one primary advantage of this method (Hair *et al.*, 2014). The RMSEA measures the difference between the observed and estimated covariance matrices per degree of freedom (Medsker *et al.*, 1994). The RMSEA considers the error of approximation in the population. The lower RMSEA values shows better fit (Hair *et al.*, 2014). In specific, RMSEA values having 0.08 to 0.10 indicate mediocre fit and the values greater than 0.10 represent poor fit (MacCallum *et al.*, 1996). However, the threshold of good values such as 0.05 or 0.08 still remains debatable (Hair *et al.*, 2014).

The RMR implies an average of the residuals. The SRMR signifies the average standardised residual. The two indices were developed to correct that standardised residuals do not reflect overall model fit. The RMR has a difficulty in comparing fit between models however the SRMR is a useful method to compare fit among models (Hair *et al.*, 2014). Although statistical criteria have not yet been established, lower RMR and SRMR values are considered to indicate better fit. SRMR values over 0.1 implies a problematic fit and SRMR values of 0.05 or less represent good fit (Byrne, 2010). SRMR values of less than 0.08 are acceptable (Hu and Bentler, 1999). With regard to sample size, the combination use of RMSEA and SRMR is recommended when the sample size exceeds 250 (Browne *et al.*, 1993). However, the SRMR and the other recommended indices, not RMSEA, should be utilised with the sample size of smaller than 250 (Holbert and Stephenson, 2002).

Normed Chi-square (χ^2) (CMIN/DF) is a proportion of Chi-square (χ^2) to the degrees of freedom (Hair *et al.*, 2014). The ratio as low as 2 or as high as 5 for representing a reasonable model fit has been utilised by different authors (Marsh and Hocevar, 1985). For example, Hair *et al.* (2014) suggest the proportion of 3 or less for a better-fitting model. On the other hand, Marsh *et al.* (1985) recommend Normed Chi-square (χ^2) of less than 2. However, normed Chi-square (χ^2) (CMIN/DF) should be dismissed or not be reported because it performs poorly and therefore is not reasonable for assessing fit (Bollen, 1989; Hu and Bentler, 1999).

Incremental fit indices assess how well the estimated model fits when compared to a baseline model. The baseline model, sometimes named as a null model, assumes uncorrelated relationship among all observed variables. This is a great difference from absolute fit indices. The incremental fit indices represent the improvement of model fit by specification of constructs (Hair *et al.*, 2014).

The incremental fit indices consist of Normed Fit Index (NFI), Comparative Fit Index (CFI), Tucker Lewis Index (TLI), Relative Noncentrality Index (RNI), and Incremental Index of Fit (IFI). Among those indices, TLI and CFI are the most dominantly used (Hair *et al.*, 2014).

NFI is calculated by the ratio of the difference in the Chi-square (χ^2) value for a fitted model and a null model to the Chi-square (χ^2) value for a null model. An NFI of 1 indicates perfect fit. However, artificial inflation of the estimate of model fit has led to less employment of this method (Hair *et al.*, 2014).

CFI was achieved from improvement of NFI by taking sample size account (Byrne, 2010). The CFI has many desirable properties such as insensitivity to model complexity and the index is most widely reported (Hair *et al.*, 2014).

Both NFI and CFI are computed by comparing a hypothesised model with a null model (Byrne, 2010). The NFI and CFI over 0.9 represent a good model fit (Baumgartner and Homburg, 1996). However, Hu and Bentler (1999) advise more rigorous values exceeding 0.95.

The TLI compares the normed chi-square (χ^2) values for a specified and null model. TLI value close to 1 indicates good fit (Hair *et al.*, 2014). An acceptable threshold for this index should exceed 0.90 (Hulland *et al.*, 1996). RNI values are also obtained by the comparison of the fits of a specific and a null model and the value over 0.9 is associated with a good fit (Hair *et al.*, 2014). In addition, IFI deals with the issues such as parsimony and sample size related to NFI by considering degrees of freedom (Byrne, 2010).

Parsimony fit indices associate model fit with model complexity and provide the best model among a set of competing models. These indices are useful in evaluating competing models. Representative indices are Adjusted Goodness of Fit Index (AGFI) and Parsimony Normed Fit Index (PNFI) (Hair *et al.*, 2014). AGFI is sometimes classified into absolute fit indices. AGFI values close to 1 indicates good fit (Byrne, 2010). However, AGFI is not recommended because it badly performs (Hu and Bentler, 1999). PNFI is the most widely applied method. Relatively high values of the PNFI indicate relatively better fit (Hair *et al.*, 2014).

The entire set of fit indices needs not to be reported (Byrne, 2010). With reporting of Chi-square (χ^2) value and degrees of freedom, adequate evidence of model fit should be composed of three or four fit indices. The evidence of model fit should include at least one absolute and one incremental index such as CFI or TLI, RMSEA or SRMR and PNFI (in the case of models comparison) (Hair *et al.*, 2014).

It is also important to note that the indices do not guarantee the usefulness of a model and only give information pertaining to the lack of model fit. The multiple criteria deriving from theoretical, statistical and practical considerations should be the grounds for the assessment of model adequacy (Byrne, 2010).

The evaluation of a measurement model fit should be performed through one analysis for the entire model instead of through a separate analysis for each construct. This is because the GOF indices aims at testing the entire model and the separate analysis cannot test discriminant validity among constructs and cannot identify cross loadings (Hair *et al.*, 2014).

In addition, for the purpose of achieving good model fit, the decrease of the number of items per construct and a test with a small number of composite indicators or smaller model specifications should be restrained. These can obscure the qualities of items and diminish the theoretical domain and validity of the model (Hair *et al.*, 2014).

It is not practical and difficult to choose a single set of threshold rules that can be applied to all SEM models because of various and different conditions (Hu and Bentler, 1999; Hair *et al.*, 2014). Nevertheless, the thresholds for GOF measure can be suggested based on the early discussion as seen in Table A14-2.

Table A14-2 Thresholds of model fit

Category	Fit index	Criterion	Reference
Absolute	χ^2	Non-significant	Marsh and Hocevar (1985) *et al.*
	GFI	> 0.9	Hair *et al.* (2014)
		Not recommended	Hu and Bentler (1999)
	RMSEA	< 0.08 or < 0.05 (debatable)	Hair *et al.* (2014)
		0.08 ~ 0.10 (mediocre)	MacCallum *et al.* (1996)
		sample over 250	Browne *et al.* (1993)
	RMR	Lower	Hair *et al.* (2014)
	SRMR	≤ 0.05	Byrne (2010)
		< 0.08	Acceptable (Hu and Bentler, 1999)
		sample less than 250	Holbert and Stephenson (2002)
	Normed χ^2	2~5	Marsh and Hocevar (1985)
		≤ 3	Hair *et al.* (2014)
		< 2	Marsh *et al.* (1985)
		Not recommended	Bollen (1989) Hu and Bentler (1999)
Incremental	NFI	> 0.9	Baumgartner and Homburg (1996)
		Less used	Hair *et al.* (2014)
	CFI	> 0.9	Baumgartner and Homburg (1996)
		Widely used	Hair *et al.* (2014)
	TLI	> 0.9	Hulland *et al.* (1996)
		Widely used	Hair *et al.* (2014)
	RNI	> 0.9	Hair *et al.* (2014)
	IFI	> 0.9	Byrne (2010)
Parsimony	AGFI	> 0.9	Byrne (2010)
		Not recommended	Hu and Bentler (1999)
	PNFI	Higher value	Hair *et al.* (2014)

3. Construct validity

Convergent validity can be assessed by the extent to which all items in a construct are correlated (Hair *et al.*, 2014). If two indicators of the same construct are substantially correlated, then convergent validity is supported (Marsh *et al.*, 1985). Magnitude and significance of standardised factor loadings between constructs and indicators, Average Variance Extracted (AVE), reliability (Hair *et al.*, 2014) and overall model fit of a measurement model can be used to assess convergent validity (Garver and Mentzer, 1999).

Standardised factor loadings estimates should be at least 0.5 and ideally 0.7 or higher and at a minimum the estimates should be statistically significant (at $\alpha \leq 0.05$ and a corresponding t value ≥ 1.96) (Garver and Mentzer, 1999; Hair *et al.*, 2014). The square of a standardised factor loading, the variance extracted of the item indicates how the latent factor explains the variation in an item. If a standardised factor loading exceeds 0.71, the squared score would equal 0.5. Those scores would indicate that the factor is explaining half the variation in the item and half the variance in the error (Hair *et al.*, 2014). In other words, at least 50% of the variance in an item should be explained by the factor. For that reason, a standardised factor loading ideally needs to be over 0.7 (Garver and Mentzer, 1999).

AVE is a summary indicator of convergent validity. AVE is represented by the sum of squared standardised loadings of all items on a factor divided by the number of the items (i.e. the average squared standardised factor loading or average communality) (Hair *et al.*, 2014). Each latent construct has each AVE value and a 0.5 or higher AVE value is regarded as having adequate convergence (Garver and Mentzer, 1999; Hair *et al.*, 2014). The expression of AVE is as follows:

$$AVE = \frac{\sum_i^n L_i^2}{n} \quad \text{[Appendix 14.3]}$$

Where, L_i is the standardised factor loading of item i and n is the total number of items (Hair *et al.*, 2014).

The consistency of the measurement scale is assessed by reliability (Churchill Jr and Peter, 1984). Reliability deals with whether a scale can present consistent results in spite of passage of time or not (Garver and Mentzer, 1999). In other words, reliability is the degree to which a construct is measured by the indicators all of which are presumed to measure the construct and reliability has an inverse relationship with measurement error (Hair *et al.*, 2014). Reliability can be assessed only after unidimensionality is achieved (Gerbing and Anderson, 1988; Garver and Mentzer, 1999).

There are two tests for reliability: one is to retest targeting the same respondents and the other is assessing internal consistency (Hair *et al.*, 2014). However, receiving two answers from the same respondents is practically a difficult task and it is better for test-retest method to be utilised supplementarily (Saunders *et al.*, 2016). That is why assessment of internal consistency is commonly used (Hair *et al.*, 2014).

Internal consistency is the extent to which all items in a construct have consistency among them. Items with high internal consistency are assumed to measure the same construct and to highly correlated (Hair *et al.*, 2014). With regard to assessment of internal consistency, although internal consistency can be calculated by a variety of methods (Saunders *et al.*, 2016), Cronbach's alpha (Coefficient alpha) is widely used for the calculation of reliability (Garver and Mentzer, 1999; Hair *et al.*, 2014). "Cronbach's alpha was designed to only measure internal consistency via correlation" (Lombard *et al.*, 2002, p.593). The threshold of Cronbach's alpha is 0.70 (Garver and Mentzer, 1999). To put it another way, "values of 0.7 or above indicate that the questions combined in the scale are measuring the same thing" (Saunders *et al.*, 2016, p.451). In the case of exploratory research, the score can be lowered to 0.6 (Hair *et al.*, 2014).

However, there are two problems with the Cronbach's alpha (Hair *et al.*, 2014). Cronbach's alpha has positive relationship to the number of items (Garver and Mentzer, 1999; Hair *et al.*, 2014). In spite of the same degree of inter-correlation, the more items can lead to the increase of the reliability value (Hair *et al.*, 2014). In addition, the assumption of Cronbach's alpha that all items have equal reliabilities can rarely be met (Bollen, 1989).

CFA1 also provides different construct (or composite) reliability (CR) value from Cronbach's alpha for internal consistency. The CR can be calculated by the following expression [Appendix 14.4] (Hair *et al.*, 2014):

$$CR = \frac{(\sum_{i=1}^{n} L_i)^2}{(\sum_{i=1}^{n} L_i)^2 + (\sum_{i}^{n} e_i)} \qquad \text{[Appendix 14.4]}$$

Where, $(\sum_{i=1}^{n} L_i)^2$ is the square of the sum of standardised factor loadings (L_i) for each construct and $(\sum_{i}^{n} e_i)$ represents the sum of the error variance terms for a construct (Hair *et al.*, 2014). The error variance is computed by 1 minus the square of each indicator's standardised factor loading (i.e. e_i = 1 - L_i^2) (Garver and Mentzer, 1999). The CR with 0.7 or higher value suggests good reliability. High CR value means that internal consistency exists and the same latent construct is consistently represented by all the items comprising the construct (Hair *et al.*, 2014).

Discriminant validity is the extent of distinctiveness of a construct from the other constructs (Hair *et al.*, 2014). Discriminant validity is particularly essential when constructs are highly correlated and similar each other (Garver and Mentzer, 1999). The existence of discriminant validity also implies that cross loadings do not exist (Hair *et al.*, 2014).

Two ways of evaluating discriminant validity are provided by CFA1. One method is the comparison of fits between two-construct model and one-construct model (i.e. the correlation of the two constructs are specified as equal to one). Discriminant validity can be supported if a fit of the two-construct model has a significant difference from that of a one-construct model (Hair *et al.*, 2014). Specifically, the difference for the chi-square value and degrees of freedom are compared to a chi-square table. The statistical significance of the difference implies the existence of discriminant validity between two constructs (Garver and Mentzer, 1999). The other method is comparing the AVE values for any two constructs with the squared correlation estimates between the two constructs. This method is more rigorous than the comparison of fits. If the two AVE values are greater than the squared correlation estimates, the discriminant validity is supported (Hair *et al.*, 2014).

As a complementary test of discriminant validity, a correlation confidence interval between two constructs can be used (Jöreskog and Sörbom, 1993).

When the confidence interval does not include 1, the discriminant validity is achieved (Anderson and Gerbing, 1988).

Content validity should be established before any theoretical test is performed when using CFA1. Content validity is referred to as the extent to which the contents of the items conform to the construction definition. The content validity should be identified through the researcher's judgement, expert judges, or other pre-tests because formal statistical tests for content validity do not exist (Hair *et al.*, 2014). In this context, testing for content validity can be recognised as subjective (Garver and Mentzer, 1999).

Predictive validity in a measurement model can be tested through comparing the reasonability of correlations of a construct to other constructs that the construct is designed to predict (Dunn *et al.*, 1994; Hair *et al.*, 2014). Predictive validity can also be tested within the process of nomological validity (Garver and Mentzer, 1999). Nomological validity implies the degree to which a construct can accurately predict other constructs that it is supposed to predict in a theoretical model (Mentzer and Flint, 1997; Hair *et al.*, 2014). The nomological validity test needs a structural model (Garver and Mentzer, 1999). The nomological validity should be supported both theoretically and empirically (Hair *et al.*, 2014).

Based on the above discussion, the criteria on construct validity can be summarised as Table A14-3.

Table A14-3 Criteria on construct validity

<table>
<tr><th>Validity</th><th colspan="3">Criterion</th><th>References</th></tr>
<tr><td rowspan="5">convergent</td><td colspan="2">Significant standardised factor loading</td><td>≥ 0.7</td><td>Garver and Mentzer (1999)
Hair et al. (2014)</td></tr>
<tr><td colspan="2">AVE</td><td>≥ 0.5</td><td>Garver and Mentzer (1999)
Hair et al. (2014)</td></tr>
<tr><td rowspan="2">Reliability</td><td>Cronbach's α</td><td>≥ 0.7</td><td rowspan="2">Garver and Mentzer (1999)
Hair et al. (2014)</td></tr>
<tr><td>CR</td><td>≥ 0.7</td></tr>
<tr><td colspan="2">Overall model fit</td><td colspan="2">According to Table 4-6</td></tr>
<tr><td rowspan="3">Discriminant</td><td colspan="3">Significant $\Delta\chi^2$ statistic</td><td>Garver and Mentzer (1999)
Hair et al. (2014)</td></tr>
<tr><td colspan="3">AVE $>$ square of correlation</td><td>Hair et al. (2014)</td></tr>
<tr><td colspan="3">Correlation confidence interval should not include 1</td><td>Jöreskog and Bollen (1993)</td></tr>
<tr><td>Content</td><td colspan="3">subjective</td><td>Garver and Mentzer (1999)</td></tr>
<tr><td>Nomological</td><td colspan="3">The extent to how well a construct predicts other constructs</td><td>Mentzer and Flint (1997)
Hair et al. (2014)</td></tr>
</table>

4. Reflective construct and formative construct

A reflective measurement theory assumes that the measured variables are caused by latent constructs and the error terms of the items imply the extent to which the latent constructs identified cannot fully explain the items. In contrast, a formative measurement theory presumes that each item is a cause of the construct. A construct in a formative measurement theory is not a latent variable anymore. In CFA1 and SEM, a reflective measurement model is conventional (Hair *et al.*, 2014).

5. A first and second order factor measurement model

A first order factor is defined as a unidimensional factor which its indicators directly determine. A second order factor implies a combination of first order factors which are supposed to be embedded within the second order factor. In a second order measurement model, the first order factors function as the multiple indicators which the second order factor causes. When the correlation coefficients between first order factors exceed the relatively high value of 0.7, the specification of a second order factor measurement model can be justified. Theoretical considerations as well as the statistical considerations can also justify the specification of the second order factor (Garver and Mentzer, 1999).

6. An identification problem

Identification addresses whether a solution to a set of structural equations can be identified by enough information (Hair *et al.*, 2014). With relation to identification, a construct should have at least three (Steenkamp and Van Trijp,

1991) or four items. Constructs with fewer than three items should be avoided (Hair *et al.*, 2014). A model with only two indicators per factor can cause identification problems (Garver and Mentzer, 1999). A construct with a single indicator cannot perfectly be estimated by the indicator (Anderson and Gerbing, 1988).

Model identification is defined as the degrees of freedom of a model after all the parameters are specified. The model identification can be calculated by given information minus the number of parameters to be estimated. In a CFA1 or SEM model, given information can be achieved by a sample covariance matrix and be calculated by $1/2[(p)(p+1)]$, where p is the number of measured items (Hair *et al.*, 2014).

The following three levels of identification exist (Byrne, 2010; Hair *et al.*, 2014):

- An under-identified model has less information such as unique indicator variable variances and covariances than the number of parameters to be estimated. An under-identified model cannot find a unique solution.
- A just-identified model has the same amount of information as the number of parameters to be estimated (i.e. zero degrees of freedom of the model). This model is defined as a saturated model.
- An over-identified model has more information than parameters to be estimated (i.e. positive degrees of freedom of a model). This model can find a solution.

Therefore, an over-identified model (or constructs) is more desirable in applying CFA1 and SEM models (Bentler and Chou, 1987; Hair *et al.*, 2014).

7. The assumption of unidimensionality

Unidimensionality means that a set of indicators can be explained by only one underlying construct (Garver and Mentzer, 1999; Hair *et al.*, 2014). It addresses whether only one construct underlying a set of items does exist or not (Kumar and Dillon, 1987). The assumption of unidimensionality implies that each item is hypothesised to be loaded highly on a single construct and all cross loadings to be zero. EFA and CFA1 can be used to assess the unidimensionality of the items (Hair *et al.*, 2014). However, CFA1 provides more rigorous and precise test results for unidimensionality than EFA (Garver and Mentzer, 1999). In standard CFA1 applications, all measured items should be free to load only on one construct (Hair *et al.*, 2014). Strong evidence of construct unidimensionality in CFA1 includes good model fit, relatively small values of standardised residuals and MIs. In addition, statistically significant parameter estimates should exceed 0.7 (Garver and Mentzer, 1999).

8. Cross loadings and covariance between error terms

A significant cross loading can produce an improved model fit. However, a cross loading cannot be hypothesised in the sense that the cross loading implies a corresponding lack of construct validity. The CFA1 model should also be run without freeing (estimating) covariance between error terms of indicator variables (Hair *et al.*, 2014).

There are two types of covariance between error terms: within-construct error covariance (covariance among error terms of items in the same construct) and between-construct error covariance (covariance among error terms of items in the different constructs). The estimating covariance among error terms can decrease Chi-square (χ^2) value and therefore improve model fit. However, the setting of between-construct error covariance is not desirable. This is because the existence of significant between-construct error covariance implies a high correlation between the two items linked to the two error terms, which is evidence of cross loading and the lack of discriminant validity (Hair *et al.*, 2014). The estimation of within-construct error covariance also should be avoided because such estimation can lead to ambiguity in reliability estimates (Bollen, 1989).

A congeneric measurement model is referred to as the model hypothesising no covariance between or within construct error variances and having several unidimensional constructs with no cross loadings. A congeneric measurement model is considered to have good measurement properties (Hair *et al.*, 2014).